



# Credit Rating Methodology

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# Overview of Methodology

By Heather Brilliant, CFA

Morningstar's credit rating process builds upon the knowledge of companies we have amassed over the past decade. Just as our equity research methodology is forward looking and based on fundamental company research, our credit rating methodology is prospective and focuses on our expectations of future cash flows. Four key components drive the Morningstar credit rating:

1. Business Risk, which encompasses country and industry risk factors, as well as Morningstar's proprietary Economic Moat™ and Uncertainty Ratings.
2. Cash-Flow Cushion™, a set of proprietary, forward-looking measures based on our analysts' forecasts of cash flows and financial obligations.
3. Solvency Score™, a proprietary scoring system that measures a firm's leverage, liquidity, and profitability.
4. Distance to Default, a quantitative model that estimates the probability of a firm falling into financial distress based on the market value and volatility of its assets.

A company's scores in each area culminate in our final credit rating. Underlying this rating is a fundamentally focused methodology and a robust, standardized set of procedures and core financial risk and valuation tools used by Morningstar's securities analysts. In this document, we provide a detailed overview of how the Morningstar Credit Rating is derived, and also outline the analytical work that feeds into our coverage of companies.

## Business Risk Evaluation

There are two key elements that comprise our assessment of a firm's business risk: 1 – economic moat analysis and 2 – uncertainty analysis.

### *Morningstar's Economic Moat Rating*

When it comes to company risk, our assessment of a firm's economic moat is the most important factor. The concept of an economic moat plays a vital role not only in our qualitative assessment of a firm's long-term cash generation potential, but also in the actual calculation and evaluation of the credit rating.

"Economic moat" is a term Warren Buffett uses to describe the sustainability of a company's future economic profits. We define economic profits as returns on invested capital, or ROICs, over and above our estimate of a firm's cost of capital, or WACC (Weighted Average Cost of Capital). Competitive forces in a free-market economy tend to chip away at firms that earn economic profits, because eventually competitors attracted to those profits will employ strategies to capture some of those excess returns. We see the primary differentiating factor among firms as being how long they can hold competitors at bay. Only firms with economic moats – something inherent in their business model that rivals cannot easily replicate – can stave off competitive forces for a prolonged period.

We assign one of three Economic Moat™ ratings: none, narrow, or wide. There are two major requirements for firms to earn either a narrow or wide rating: 1 – The prospect of earning above-average returns on capital; and 2 – Some competitive edge that prevents these returns from quickly eroding. To assess the sustainability

of excess profits, analysts perform ongoing assessments of what we call the Moat Trend™. A firm's Moat Trend™ is positive in cases where we think its competitive advantage is growing stronger, stable where we don't anticipate changes to our moat rating over the next several years, and negative when we see signs of deterioration. The assumptions that we make about a firm's economic moat play a vital role in determining the length of "economic outperformance" that we assume in our cash flow model.

Our analysts must vet any proposed changes to the Economic Moat ratings of their companies with senior managers in Morningstar's equity research department. This layer of accountability underscores the impact our Economic Moat ratings have on our valuation and ratings processes, as well as on the many products and services that Morningstar provides.

Evaluating the competitive dynamics and moats specific to the industry in which a firm operates is also central to our methodology. Even the best operator in the auto parts industry, for example, would have a hard time overcoming bankruptcies of its core clients. Our industry analyses are communicated across the analyst department so we can consistently evaluate firms in similar industries.

#### *Uncertainty Analysis*

Morningstar's Uncertainty Rating measures the predictability of future cash flows, based on the characteristics of the business underlying the stock. Our framework decomposes the uncertainty around company value into four simplified conceptual elements: range of sales, operating leverage, financial leverage, and contingent events. Some industries require special adjustments to this formula, but the basic framework remains focused on bounding the range of the long run cash generating value of the firm.

### **Assessing Financial Risk**

In evaluating financial risk, we score companies on the following three metrics:

#### *Cash Flow Cushion™*

Our proprietary Cash Flow Cushion™ ratio gives us insight into whether a company can meet its capital obligations well into the future. We make adjustments to the firm's reported operating cash flow to derive its cash available for servicing its obligations, and compare our forecasts for that cash to the company's future debt-related obligations, including interest and debt maturities.

#### *Solvency Score™*

We consider several ratios to assess a firm's financial strength, including the size of a company's obligations relative to its assets, and the firm's debt burden relative to its cash flow. In addition to examining these ratios in past years, our analysts explicitly forecast the cash flows we think a company is likely to earn in the future, and consider how these balance sheet ratios will change over time. In addition to industry-standard measures of profitability (such as profit margins and returns on equity), we focus on return on invested capital as a key metric in determining whether a company's profits will benefit debt and equity holders. At Morningstar, we have been focusing on returns on invested capital to evaluate companies for more than a decade, and we think it is particularly important to understand a firm's ability to generate returns on capital in excess of its cost of capital in order to accurately assess its prospects for meeting debt obligations.

#### *Distance to Default*

Morningstar's quantitative Distance to Default measure ranks companies on the likelihood that they will tumble into financial distress. The measure treats a company's equity as a call option on the company's assets, with the total liabilities being the strike price. The more likely the company's asset value is to fall below the value of the firm's liabilities, the greater the likelihood of financial distress. The Distance to Default expresses how many standard deviations separate the current value of assets from the strike price. Our proprietary metric is particularly conservative as we use 100% of total liabilities in calculating the Distance to Default.

## **Modeling Cash Flows**

Analyzing current and past financial statements is important, but a company's ability to meet its debt obligation can't be determined by gazing in the rear-view mirror. That's why our analysts create a detailed projection of a company's future cash flows, based on their independent primary research. Analysts create custom industry and company assumptions to feed income statement, balance sheet, and cash flow assumptions into our standardized, proprietary discounted cash flow modeling templates. We use scenario analysis and a variety of other analytical tools to augment this process. Analysts use a standard operating company model to forecast the vast majority of our covered firms. But, we have also developed specialized models for determining credit ratings and valuations for banks, insurance firms, and real estate investment trusts (REITs).

As a result of our methodology, our model is divided into three distinct stages. Here is how the system works in practice for operating companies:

### *First Stage*

In the first stage of our model, analysts make numerous detailed assumptions about items such as revenue, profit margins, tax rates, changes in working capital accounts, capital spending, financing requirements, and potential cash flow generation. These assumptions span a period ranging from five to 10 years, and they result in detailed forecasts of the company's income statement, balance sheet and cash flow statement during that time period. These projections are a key driver in determining our Credit Rating for a given company.

### *Second Stage*

The length of the second stage depends on the strength of the company's economic moat. We define the second stage of our model as the period it will take the company's return on incremental invested capital to decline (or rise) to its cost of capital. We forecast this period to last anywhere from 0 years (for companies with no economic moat) to 25 years (for some wide-moat companies).

### *Third Stage: Perpetuity*

In the final stage, we calculate a continuing value using a standard perpetuity formula. At perpetuity, the return on new investment is set equal to the firm's real WACC, which is our discount rate minus inflation, net of assumed asset decay. At this point, we believe the firm will no longer be able to invest in new projects to earn a profit greater than its cost of capital. Thus, the company could be generating significant free cash flow – the more free cash flow, the higher the value – but any net new investment would destroy value for stakeholders.

Analysts look for off balance-sheet assets and liabilities, and adjust their estimates of a firm's value to incorporate these impacts. The cash flows from all three stages are then discounted to the present value using the WACC. By summing the discounted free cash flows from each period, we arrive at an enterprise value for the firm. Then we can determine a firm's long-run ability to meet its debt obligations as well as calculate a fair value for the common stock. The calculations differ for financial firms, but the logic and reasoning behind our valuation remains the same for these firms as it does for operating companies.

### *Scenario Analysis*

A core part of our research process is to perform scenario analysis on each company we cover. Our analysts typically model three to five different scenarios, stress-testing the model and examining the distribution of resulting enterprise values. Such scenario analysis incorporates each analyst's assessment of both business and financial risk.

### **The Morningstar Credit Rating**

We use our assessment of a firm's future cash flows, Economic Moat, Uncertainty, and financial risk to arrive at an overall credit rating for the firm. Our ratings are completely independent, objective, and forward looking. We place considerable emphasis on marrying qualitative and quantitative analysis to arrive at our Credit Ratings. We apply weightings to each factor we consider, placing particular emphasis on some of the proprietary metrics we have honed over time, including Economic Moat. Using these factors, we rate firms on an industry-standard scale, as described in the table on the right.

AAA	Extremely Low Default Risk
AA	Very Low Default Risk
A	Low Default Risk
BBB	Moderate Default Risk
BB	Above Average Default Risk
B	High Default Risk
CCC	Currently Very High Default Risk
CC	Currently Extreme Default Risk
C	Imminent Payment Default
D	Payment Default

# Components of our Credit Ratings

## The Cash Flow Cushion™

By Brian Nelson, CFA

Morningstar's proprietary Cash Flow Cushion™ ratio is a fundamental indicator of a firm's future financial health, and is a key component of the Morningstar Credit Rating. The measure reveals how many times a company's internal cash generation plus total excess liquid cash will cover its debt-like contractual commitments over the next 5 years. At its core, the Cash Flow Cushion™ acts as a predictor of financial distress, bringing to light potential refinancing, operational, and/or liquidity risk inherent to the firm.

The advantage of the Cash Flow Cushion™ ratio relative to other fundamental indicators of credit health is that the measure focuses on the future cash-generating performance of the firm via Morningstar's proprietary discounted cash flow model. By reclassifying certain cash expenses as liabilities to reflect their debt-like characteristics, our analysts compare future projected free cash flows with debt-like cash commitments coming due in any particular year. The forward-looking nature of this metric allows the analyst to better anticipate changes in a firm's financial health, and pinpoint periods where cash shortfalls are likely to occur. Here is the formulaic representation of the Cash Flow Cushion™ ratio used as a component of the Morningstar Credit Rating:

$$\frac{\text{TotalLiquidCash}_{Yr0} + \sum_{Yr1}^{Yr5} \text{AdjustedFreeCashFlow}}{\sum_{Yr1}^{Yr5} \text{DebtlikeContractualCommitments}}$$

### Nuts & Bolts

Typically, a bond default occurs as a result of any missed or delayed payment of interest or principal, resulting in either bankruptcy or a distressed securities issuance. As such, the Cash Flow Cushion™ focuses on the timing of interest and principal payments (including the debt of joint ventures, if necessary) and considers other debt-like (off-balance sheet) mandatory cash contractual commitments—including lease payments, pension/post retirement contributions, guarantees, legal contingent obligations, etc. that, if left unpaid, may ultimately lead to financial distress and/or bankruptcy. The sum of a firm's total cash obligations and commitments over the next five years forms the denominator in the calculation of the firm's Cash Flow Cushion.™

Let's walk through an assessment of a firm's debt-like commitments, using 3M as an example:

	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13
<b>Contractual Obligations</b>					
(Debt Maturity Schedule)	(892)	(109)	(899)	(723)	(849)
(Interest Expense)	(282)	(239)	(238)	(202)	(179)
(Cash Lease Payments)	(111)	(73)	(57)	(32)	(22)
(Cash Pension Contributions)	(725)	(300)	0	0	0
(Capital Leases)	(8)	(7)	(7)	(6)	(5)
<b>Total Cash Obligations and Commitments</b>	<b>(2,018)</b>	<b>(728)</b>	<b>(1,201)</b>	<b>(963)</b>	<b>(1,055)</b>

As the table above reveals, 3M faces a manageable debt maturity schedule, with just over 10% of its total debt (\$6.1 billion) coming due in each year, on average, during the next five years. We see that 3M is also on the hook for over \$1 billion in cash pension contributions through 2010, as the firm's retirement plans were severely underfunded at the end of 2008 due to declining global markets. However, we don't think the firm will have any cash pension contributions beyond 2010 due to rebounding equity values, which should ease that burden. We also consider 3M's cash interest payments, as well as cash outlays for capital leases in arriving at the firm's total cash obligations and commitments.

After assessing the firm's debt profile and other cash needs, analysts then back out the cash components of expense items included in net income from continuing operations that resemble debt-like contractual cash commitments. This may include rent expense, pension expense, and other operating items, but not maturing debt or other items that were not initially in net income. For example, if a cash debt-like expense item is originally included in net income from continuing operations, analysts add the cash components of that item back to net income from continuing operations before including it in total cash obligations and commitments to avoid double counting. These adjusted items are then tax-effected to arrive at the firm's adjusted net income from continuing operations.

Sticking with our 3M example, we consider the cash components of interest expense, rent expense, pension expense (pension service cost), and capital lease expense in arriving at adjusted net income from continuing operations for the company, per the following:

	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13
<b>Adjusted Free Cash Flow</b>					
Net Income from Continuing Ops	3,128	3,479	4,102	4,101	4,415
Interest Expense, tax-effected	195	165	164	139	124
Rent Expense, tax-effected	77	50	39	22	15
Pension Service Cost, tax-effected	234	245	263	283	303
Capital Lease Expense, tax effected	6	5	5	4	3
<b>Adjusted Net Income from Continuing Operations</b>	<b>3,639</b>	<b>3,944</b>	<b>4,574</b>	<b>4,549</b>	<b>4,860</b>

Our analyst's forecast of 3M's adjusted net income from continuing operations is then used to arrive at adjusted cash flow from operations. In 3M's case, we expect accounts receivable and inventory--two components of net working capital--to fall as a result of sharply declining sales, generating cash for the firm during 2009. However, we forecast rebounding revenue beginning in 2010, which will likely require working-capital investment--a use of cash:

	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13
<b>Adjusted Free Cash Flow</b>					
Net Income from Continuing Ops	3,128	3,479	4,102	4,101	4,415
Interest Expense, tax-effected	195	165	164	139	124
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Depreciation Expense	1,071	1,122	1,204	1,293	1,386
Amortization of Other Intangibles	0	0	0	0	0
Impairment of Goodwill	0	0	0	0	0
Other Non-Cash Adjustments to Operating Income	(195)	(204)	(219)	(249)	(267)
Deferred Income Taxes & Other Adjustments to Net Income	0	0	0	0	0
Changes in Operating Assets and Liabilities					
(Increase) Decrease in Accounts Receivable	272	(139)	(225)	(242)	(260)
(Increase) Decrease in Inventory	159	(80)	(97)	(223)	(236)
(Increase) Other Short-Term Operating Assets	0	0	0	0	0
Increase (Decrease) in Accounts Payable	(84)	58	43	109	103
Increase (Decrease) in Other Current Liabilities	0	0	0	0	0
<b>Adjusted Cash Flow from Operations</b>	<b>4,861</b>	<b>4,701</b>	<b>5,280</b>	<b>5,236</b>	<b>5,586</b>

The firm's total capital expenditures, asset sales/dispositions, acquisitions, and cash flows related to investments in long-term operating assets are then subtracted from adjusted cash flow from operations in arriving at the analyst's assessment of the company's adjusted free cash flow. 3M has been highly acquisitive during the recent past, spending nearly \$3 billion to purchase companies over the past three years. We expect this pace to slow somewhat, but we still forecast continued spending on both acquisitions and capital expenditures to fund internal growth, as the table below shows:

	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13
<b>Adjusted Cash Flow from Operations</b>	<b>4,861</b>	<b>4,701</b>	<b>5,280</b>	<b>5,236</b>	<b>5,586</b>
(Capital Expenditures)	(1,030)	(1,000)	(1,000)	(1,000)	(1,000)
Asset Sales & Dispositions of Discontinued Operations	0	0	0	0	0
(Acquisitions) and (Increase) Decrease in Net Long Term Operating Assets	(347)	(363)	(390)	(419)	(419)
Additions/Subtractions to Adjusted Free Cash Flow	0	0	0	0	0
<b>Adjusted Free Cash Flow</b>	<b>3,485</b>	<b>3,338</b>	<b>3,890</b>	<b>3,818</b>	<b>4,168</b>

The sum of the analyst-adjusted free cash flows for 3M over the next five years is then added to the firm's current total excess liquid cash and cash equivalents (\$1.85 billion) in forming the numerator of the Cash Flow Cushion™. In its truest form, the numerator for 3M reveals its total liquidity available to service debt-like cash commitments over the five-year period.

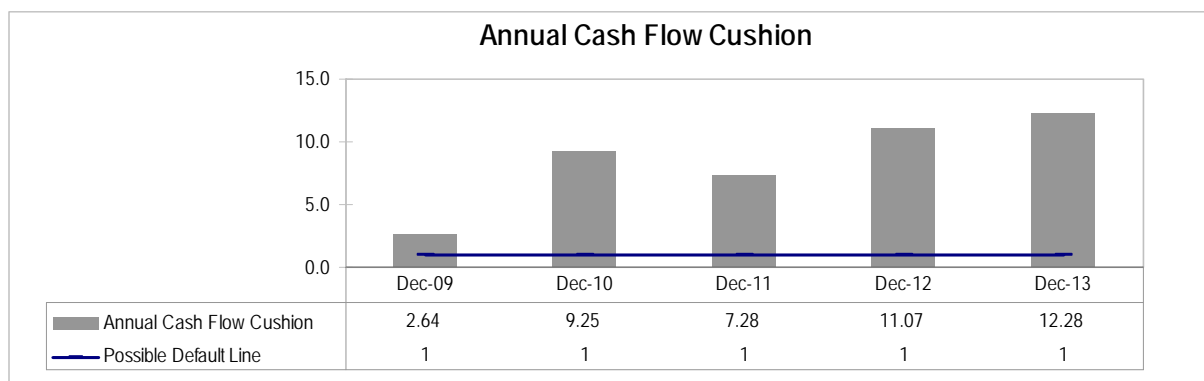
	Current	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13
<b>Liquid Cash and Cash Equivalents</b>						
Excess Cash and Cash Equivalents	1,849	3,399	4,847	6,842	8,787	11,086
(Illiquid Cash and Cash Equivalents)	0	0	0	0	0	0
<b>Total Liquid Cash and Cash Equivalents</b>	<b>1,849</b>	<b>3,399</b>	<b>4,847</b>	<b>6,842</b>	<b>8,787</b>	<b>11,086</b>

### Cash Flow Cushion™ and Morningstar Credit Rating

The Cash Flow Cushion™ ratio used in the generation of the Morningstar Credit Rating represents how many times total excess liquid cash plus internal cash generation will cover debt-like contractual commitments over the next five years. In 3M's case, we expect the firm's total cash balance plus the sum of its forward adjusted free cash flow to cover its debt-like contractual commitments 3.5 times (344.5%) over the next five years, which is a very healthy measure:

5-year Cash Flow Summary		% of Commitments
<i>Millions</i>		
Total Cash Balance (t=0)	1,849	31.0%
Sum of 5-year Forward Adj. FCF	18,698	313.5%
<b>Total Cash and Cash Generation, 5 yr</b>	<b>20,547</b>	<b>344.5%</b>
<b>Total Cash Commitments, 5 yr</b>	<b>(5,965)</b>	

Analysts also consider an annual variant of the Cash Flow Cushion™ to assess the financial health of the firm on a rolling basis. If this particular ratio falls below 1 in any forecast year, the company may be exposed to potential financial/operational distress or refinancing risk in that given year. In 3M's case, the firm's annual ratio is comfortably above the possible default line of 1, signaling that no such risk is present.



### Debt Refinancing Assessment within the Cash Flow Cushion™

Within the Cash Flow Cushion™, an analyst may make subjective assessments of the risks posed by debt maturities. We may address part of this risk using an asset adjustment in certain cases for firms with long-lived assets such as REITs and utilities. By considering the value of assets on the balance sheet such as inventory, accounts receivable, and property, plant, and equipment, we can estimate the collateral available for a lender to lend against either explicitly using secured debt, or implicitly through unsecured debt and associated covenants. Through assumptions, including approximations of market values for those assets and acceptable loan-to-value ratios, we assess whether a lender would be willing to refinance an upcoming debt maturity. The asset adjustment will offset all, part, or none of expected debt maturities in the Cash Flow Cushion™ depending on analyst assumptions in each year. For example, aggressive assumptions such as high asset values and loan-to-value ratios will create a larger borrowing base, increasing the likelihood that the asset adjustment will offset future debt maturities, thereby increasing the Cash Flow Cushion™.

### Business Risk Factors

Two separate scores converge to form our Business Risk Score: Country Risk and Company Risk. Once we assign these two component scores, we weight them as follows to determine the overall Business Risk score for each company:

Country Risk	10%
Company Risk	90%

### Country Risk

No matter how solid a company's finances, if it operates in an unstable political or economic environment, it deserves a lower credit rating than a similar firm operating under more benign conditions. Because a significant percentage of our coverage includes firms domiciled outside the United States – and those that call the United States home but have considerable non-U.S. operations – we incorporate an evaluation of country risk where appropriate. Some components that we consider are differences in expected inflation, financial disclosure, expropriation risk, and other specific operating-market differences. Country risk considerations are incorporated across the analyst department to ensure consistency. We score each country 1 to 25 (with 25 being best) based on five general areas.

### *Political Stability*

Does the country have a well-established method of transferring political power, and does it operate free of foreign interests?

### *Legal System*

Does the country have a tradition of respecting contracts and a well-established framework for settling legal disputes?

### *Interest Rate, Inflation Stability*

Is the country's political establishment committed to sound economic, monetary, and fiscal policies that result in low inflation, relatively stable interest rates, and manageable government debt?

### *Robustness of the Financial Markets/Strength of Banking System*

Does the country have a rational, predictable regulatory regime, with established, transparent rules in areas like accounting, securities-market regulation, capital requirements, and government disclosure?

### *Credit History*

Does the country have a history of respecting its debt obligations, or has the political establishment defaulted on sovereign debt or inflated it away?

## Company Risk

We score each company on seven company-specific risk factors. The emphasis here is on the inherent characteristics of the firm regardless of its current balance sheet (which we capture with other measures). Measures such as the Economic Moat and Uncertainty Rating also contain an inherent industry element. Some industries are more conducive to Economic Moats than others, and some industries have inherently higher levels of uncertainty about future cash flow.

### *Economic Moat Rating*

An essential part of our company analysis is the Economic Moat rating, which encapsulates our view as to a company's competitive advantage and ability to earn excess returns on capital. We assign a score based on a company's Economic Moat Rating, as determined by our analysts.

<b>Moat Rating</b>	<b>Score</b>
Wide	10
Narrow	5
None	1

### *Uncertainty Rating*

We assign a score based on a company's Uncertainty Rating, as determined by our analysts. Morningstar's analysts assign Uncertainty Ratings based on their estimation of the range of possible revenues over the next three years, the company's operating leverage, and the company's financial leverage. We assign the scores as follows:

<b>Uncertainty Rating</b>	<b>Score</b>
Low	10
Medium	7.5
High	5
Very High	2.5
Extreme	1

### *Size*

Smaller companies are inherently less stable, and more vulnerable to financial distress, than larger firms. We assign companies a score based on revenue as follows:

<b>Annual Revenue</b>	<b>Score</b>
Greater than \$25 billion	10
Between \$13 billion and \$25 billion	9
Between \$7 billion and \$13 billion	8
Between \$4.5 billion and \$7 billion	7
Between \$3 billion and \$4.5 billion	6
Between \$1.8 billion and \$3 billion	5
Between \$1 billion and \$1.8 billion	4
Between \$500 million and \$1 billion	3
Between \$200 million and \$500 million	2
Less than \$200 million	1

### *Product & Customer Concentration*

An important factor in the stability of a company's future revenues and profits is the diversification of both its product portfolio and its customer base. Other things equal, a company with a wide variety of products sold to a variety of end markets is less subject to economic or regulatory shocks than a more-focused company. Our analysts assign a Concentration Score to their companies on a scale of 1 to 5, with diversified firms (examples: 3M and Johnson & Johnson) scoring a 5, and companies with a single product or narrow base of customers scoring a 1.

### *Stewardship Grade*

Our analysts assign each company we cover a Stewardship Grade of A through F. The Stewardship Grade captures our view of a company's transparency, board independence, incentives and ownership, and investor friendliness. We feel these are key components in determining whether a company's management team is looking out for investors (whether equity or bond holders) as opposed to their own interests. We map these grades to scores (A=5, B=4, C=3, D=2, and F=1).

### *Dependence on Capital Markets*

Our analysts score each company on its need to access the capital markets over our five-year forecast horizon. Because capital markets are inherently unpredictable, a company whose survival depends on them is more at risk than a company that can ignore the whims of the market. If the company definitely must access capital markets over the next five years, it scores a 1. If it could easily continue to operate if all capital markets closed for five years, it scores a 5.

### *Cyclicalty of Operations*

The greater the economic sensitivity of a firm, the more likely it is to go bankrupt, all else being equal. Our analysts assess the cyclicalty of each firms' operations and assign a score to those companies on a scale of 1 to 5. An extremely cyclical firm like an airline may receive a score of 1, while a stable utility may receive a score of 5.

## Morningstar Solvency Score™

By Warren Miller

Any credit scoring system would be remiss to ignore a company's current financial health as described by some key financial ratios. Perhaps the most widely known calculation for describing a company's financial health via accounting ratios is the Altman Z-Score. In our effort to create a ratio-based metric superior to the Altman Z-Score, we used binary logistic regression analysis to evaluate the predictive ability of several financial ratios commonly believed to be indicative of a company's financial health as described in the Solvency Score™ Development Appendix. This extensive testing yielded a calculation that has shown to be more predictive of corporate bankruptcy than the Altman Z-Score. We refer to it as the Morningstar Solvency Score™. Results of our performance testing can be found in the Backtesting Appendix of this document.

Financial ratios can describe four main facets of a company's financial health: liquidity (a company's ability to meet short term cash outflows), profitability (a company's ability to generate profit per unit of input), capital structure (how does the company finance its operations?), and interest coverage (how much of profit is used up by interest payments). The Morningstar Solvency Score™ includes one ratio from each of these four categories.

Although our extensive testing was based on previously reported accounting values, Morningstar's equity analysts continually forecast the very same accounting values for future time periods. No testing of our analysts' forecasts has been possible due to data limitations, but it is reasonable to assume that using analyst estimates of future accounting values will yield more predictive results than previously reported ratios. As a result, the Morningstar Solvency Score™ utilizes some analyst estimates of future ratios.

Morningstar Solvency Score™

$$5 \times \sqrt{\frac{\text{TotalLiabilities}_0}{\text{TotalAssets}_0} \times \frac{\text{InterestExpense}_1}{\text{EBITDA}_1}} - 4 \times \text{ReturnOnInvestedCapital}_1 - 1.5 \times \text{QuickRatio}_0$$

$$(1) \quad \begin{aligned} \text{InvestedCapital} = & \text{CurrentAssets} \\ & + \text{NetPPE} \\ & + \text{NetGoodwill} \\ & + \text{IntangibleAssets} \\ & + \text{LongTermOperatingAssets} \\ & - \text{ExcessCash} \\ & - \text{AccountsPayable} \\ & - \text{OtherCurrentLiabilities} \\ & - \text{LongTermOperatingLiabilities} \end{aligned}$$

Where:

$$\text{ReturnOnInvestedCapital}_1 = \frac{\text{EarningsBeforeInterest}_1}{\text{InvestedCapital}_0}$$

Part of the attractiveness of the Solvency Score™ is in its appeal to intuition. A practitioner of financial analysis will recognize that each of the ratios included has its own ability to explain default risk. See our Backtesting Appendix for greater detail. In addition, the weighting scheme and ratio interaction appeal to common sense. For instance, it is logical to assume that an interest coverage ratio would be highly predictive of default. However even healthy companies can have odd years where profits may suffer and interest coverage is poor. For this reason, a multiplicative combination of the interest coverage ratio with a capital structure ratio is more explanatory than either ratio individually, or even a linear combination of the two. This is because interest coverage is not highly important for companies with healthy balance sheets (perhaps they have cash on hand to weather even the most severe of downturns) but interest coverage becomes more important as liabilities increase as a percentage of a company's total capital structure.

The Morningstar Solvency Score™ is an integral part of Morningstar's credit rating methodology, and serves as an improvement over the more commonly used Altman Z-Score. However any default-prediction system that relies solely on reported accounting values will suffer from its reliance on the accuracy and timeliness of the input data. This is why, when possible, each input in the Morningstar Solvency Score™ is input by a Morningstar Analyst, and the coverage and profitability ratios are derived from an analyst's one-year forecast rather than previously reported values. While these measures will help combat the false positives generated by an as-reported system, the Solvency Score™, like other quantitative models, still generates a very large number of false positives, and is best used as a ranking system that can help "red flag" a particular company that may soon face financial distress. The Morningstar Cash Cushion ratio is more specifically designed to predict default with minimal false positives.

## Distance to Default

By Vahid Fathi

Instead of using accounting-based ratios to formulate a measure to reflect the financial health of the firm, this approach makes use of structural or contingent claim models. In some cases, accounting measures based on historical financial statements may have little or no bearing on the future viability of the firm. An area of weakness in accounting measures based on historical financial statements of the firm, for example, is the inherent understatement of the firm's book value in most cases, which results in overstatement of the financial leverage measures if such are to be used as a proxy of the financial health of the firm. Last, but not least, accounting measures based on historical financial statements of the firm do not account for the volatility of a firm's assets in spite of the fact that the probability of bankruptcy and a firm's asset volatility are related. For example, two firms having identical financial leverage can have significantly differing probabilities of bankruptcy depending on their assets' volatility.

All underlying financial data used to calculate the company Distance to Default scores are from Morningstar's internal equities database. Market data required for estimation of distance to default, including stock prices and the safe rate (one year treasury yield), are downloaded from current feeds available to Morningstar.

### *Structural Models*

Structural models take advantage of both market information and accounting financial information. For this purpose, option pricing models based on the seminal works of Black and Scholes (1973) and Merton (1974) are a natural fit. The firm's equity can be viewed as a call option on the value of the firm's assets. If the value of assets is not sufficient to cover the firm's liabilities at the strike price, default is expected to occur and the call option expires worthless and the firm is turned over to its creditors.

$$\text{Asset Value} = \text{Equity Value} + \text{Liabilities} \quad (1)$$

The underlying premise of contingent claim models is that default occurs when the value of the firm's assets falls below a certain threshold level in relation to the firm's liabilities. According to Merton (1974) if the firm's liabilities consist of one zero-coupon bond with notional value  $L$ , maturing in  $T$  (without any debt payment until  $T$ ), and equity holders wait until  $T$  (to benefit from an expected increase in the asset value), the default probability at time  $T$ , is that the value of assets is less than the value of the liabilities. To estimate this probability, the value of the firm's liability is obtained from the firm's latest balance sheet.

$$L_t = L_s + L_l \quad (2)$$

Where:

$L_t$  = Total Liability

$L_s$  = Short-Term Liability

$L_l$  = Long-Term Liability

Next, the probability distribution of a firm's asset value at time  $T$  needs to be estimated. It's assumed that the value of a firm's assets follows a log-normal distribution, i.e. the logarithm of the firm's asset value is normally distributed and the expected change in log asset values is  $\mu - \delta - \sigma^2 / 2$ . The log asset value in  $T$  year therefore follows a normal distribution with the following parameters:

$$\ln A_T \approx N [ \ln A^t + (\mu - \delta - \sigma_A^2 / 2) (T - t) , \sigma_A^2 (T - t) ] \quad (4)$$

Where

$\mu$  is the continuously compounded expected return on assets or the asset drift and

$\delta$  is asset yield, expressed in terms of current asset value and is equal to  
(TTM common + preferred dividends) / Current asset value

Next, the probability that a normally distributed variable  $x$  falls below  $z$  is given by

$$N\{(z - E[x]) / \sigma_A(x)\},$$

Where  $N$  denotes the cumulative standard normal distribution.

To empirically estimate the Black-Scholes probability from equation (4), we need estimates of:  $A_t$ ,  $\mu$  and  $\sigma_A$  which are not directly observable. Though if they were known there would be no need for using Black-Scholes and the probability of bankruptcy (PB) and Distance to default (DD), can be expressed (McDonald 2002) as:

$$\begin{aligned} PB &= N\{ - [ [ \ln A_t - \ln L_t + (\mu - \delta - \sigma_A^2 / 2) (T-t) ] / [ \sigma_A \sqrt{(T-t)} ] ] \} \\ &= N\{ - [ [ \ln (A_t / L_t) + (\mu - \delta - \sigma_A^2 / 2) (T-t) ] / [ \sigma_A \sqrt{(T-t)} ] ] \} \end{aligned} \quad (5)$$

$$DD = [ \ln A_t + (\mu - \delta - \sigma_A^2 / 2) (T - t) - \ln L_t ] / \sigma_A \sqrt{(T - t)} \quad (6)$$

$$\Rightarrow PB = N [ -DD ] \quad (7)$$

Equation (5) shows that the probability of bankruptcy is a function of the distance between the value of firm's assets today and the book value of firm's total liabilities ( $A_t / L_t$ ), adjusted for the expected growth in asset value, asset drift, and asset yield ( $\mu - \delta - \sigma_A^2 / 2$ ) relative to asset volatility,  $\sigma_A$ .

But the market value of the firm's assets is not observable, and can be very different than the book value of the firm's assets. This is the  $A_t$  in equation (5). Furthermore, we do not know the volatility of the market value of the firm's assets, nor we can use the observed asset values (book values) as a proxy of the firm's market value of asset volatility,  $\sigma_A$ . That's where the option pricing comes in since it implies a relationship between the unobservable ( $A_t$ ,  $\sigma_A$ ) and the observable variables. As long as the value of the firm's assets is below the book value of the firm's liabilities, the payoff to equity holders is zero. If the value of the firm's assets is higher than the book value of the firm's liabilities, equity holders receive the residual value, and their payoff increases linearly as the value of the firm's assets increases over time. This can be expressed as the payoff of a modified (for dividends) European call option:

$$E_T = \text{Max} (0, A_T - L_t) \quad (8)$$

Assuming risk-neutrality, the equity value,  $E_t$ , can be estimated by a modified (for dividends) standard Black-Scholes call option formula:

$$E_t = A_t e^{-\delta T} \cdot N(d_1) - L_t \cdot e^{-rT} \cdot N(d_2) + (1 - e^{-\delta T}) A_t \quad (9)$$

Where

$r$  is the safe rate (one year treasury yield), and  
 $N(d_1)$  and  $N(d_2)$  are the cumulative standard normal of  $d_1$  and  $d_2$ .

Dividend yield,  $\delta$ , is added to the standard Black-Scholes model in equation (9), which appears twice in the right hand side of the equation. First, term  $A_t e^{-\delta T}$  accounts for the reduction in the value of firm's assets due to dividends that are distributed at time  $T$ . Second, term  $(1 - e^{-\delta T}) A_t$  accounts for the fact that it is the equity holders that receive the dividend – these terms do not appear in the standard Black-Scholes equation for valuing a call option on a dividend paying stock since dividends are not paid to option holders:

$$d_1 = \{ \ln [A_t / L_t] + (\mu - \delta + \sigma_A^2 / 2) T \} / \sigma_A \sqrt{T} \quad (10)$$

and

$$d_2 = d_1 - \sigma_A \sqrt{T} = \{ \ln [A_t / L_t] + (\mu - \delta - \sigma_A^2 / 2) T \} / \sigma_A \sqrt{T} \quad (11)$$

Given the assumption of risk neutrality, the value of the call option derived from the standard Black-Scholes formula is not a function of a firm's asset return or drift,  $\mu$ . The risk-neutrality assumption in the Black-Scholes formula implies that assets are expected to grow at the safe rate of return and therefore only the risk free rate,  $r$ , enters the Black-Scholes equation. The actual probability of bankruptcy depends on the actual distribution of future values of assets and is a function of a firm's asset drift,  $\mu$  as per modified Black-Scholes equation (5).

The objective is the estimation of the firm's value of the asset,  $A_t$ , drift,  $\mu$  and volatility,  $\sigma_A$  though we only have one equation (9) establishing a link between the two unknown values  $A_t$  and  $\sigma_A$ .

There are different methods to obtain more information to estimate these two values. One approach is to come up with another equation that establishes another link between these two values. Then both equations can be simultaneously solved to determine these two values. The optimal hedge equation (12) below, which shows the equity volatility,  $\sigma_E$  is related to asset value,  $A_t$ , and asset volatility,  $\sigma_A$  and establishes the relationship between the two values. Again  $d_1$  in equation (12) is the standard Black-Scholes  $d_1$  per equation (10). Term  $A_t e^{-\delta T}$  in equation (12) is needed to reflect the reduction in the value of the firm's assets due to dividends that are distributed at time  $T$ :

$$\sigma_E = (A_t e^{-\delta T} N(d_1) \sigma_A) / E_t \quad (12)$$

If we know the equity value,  $E_t$  (market price times shares outstanding), and have an estimate of equity volatility,  $\sigma_E$  (annualized standard deviation of daily stocks daily log returns), equations (9) and (12) are two

equations with two unknowns ( $A_t$ ,  $\sigma_A$ ) that can be solved simultaneously for a numeric solution of the firm's asset value.

Alternatively, the firm's asset value, drift and volatility can be estimated iteratively based on daily calculations of asset values and use of CAPM. By rearranging Equation (9) we obtain asset value  $A_t$ :

$$A_t = \frac{(E_t + L_t) \cdot e^{-rT} N(d_2)}{1 - e^{-\delta T} + e^{-\delta T} N(d_1)} \quad (13)$$

These asset values can then be directly entered in the distance to default and probability of default equations (5) and (6).

The following example illustrates step by step the formulation and solution for the iterative method.

- 1- Set time horizon  $T-t = 1$  year (Actual trailing twelve month, TTM Business days)
- 2- Set the daily equity value,  $E_t$ , for the TTM by multiplying daily common stock price times shares outstanding.
- 3- Set total daily liabilities,  $L_t$ , equal to latest available quarterly sum of short term liabilities,  $L_s$ , and long term liabilities,  $L_l$ , for the TTM – note these figures remain the same for each day and only change when a newer quarterly balance sheet becomes available during the TTM period
- 4- Set daily gross common and preferred dividends paid in the TTM – use the record date instead of payout date and calculate TTM dividends and annual rate of daily asset yields
- 5- Set the daily yield for one year treasuries for the TTM
- 6- Calculate daily asset values and their volatility for the TTM – see example iteration

A firm's asset volatility is calculated as the annualized standard deviation of the preceding TTM (approximately 252) business daily log returns of asset values. To calculate daily log returns of asset values for the TTM period we simply take the natural log of day two asset value divided by the natural log of day one asset value and repeat the process for all 252 business days. Next we estimate asset drift,  $\mu$  using CAPM. To do this, first, asset beta is calculated as the log of the slope of the regression line for excess daily arithmetic returns of assets versus the market. Second the expected asset return or drift,  $\mu$  is calculated by multiplying the estimated asset beta in the previous step by the equity risk premium (assumed to be 4.8%) and add the safe rate.

Calculate Distance to Default and Probability of Bankruptcy

We now can directly enter the firm's asset volatility and drift calculated from the preceding section into the distance to and probability of default Equations (5) and (6).

# Assigning Long-Term Issuer Credit Ratings

## Mapping Scores to Preliminary Credit Ratings

By Warren Miller

There are four main components of an issuer's numerical credit score. The Solvency Score™, Distance to Default, Business Risk and Cash Flow Cushion™ are combined as shown in the equation below.

$$\text{Credit Score} = (3.5 \times DD_D) + (3.5 \times SS_D) + (8 \times BR_D) + (\text{MAX}(DD_D, SS_D, BR_D) \times CC_D)$$

Where:

$DD_D$  = Distance to Default Score

$SS_D$  = Solvency Score™ Score

$BR_D$  = Business Risk Score

$CC_D$  = Cash Flow Cushion™ Score

Our backtesting results suggest that Solvency Score™ and Distance to Default score have enhanced predictive ability when combined in equal weights. Business Risk holds greater weight than these quantitative measures, given the significant influence that country, company, and industry risks have on a firm's overall credit health and ability to meet future obligations. The equation is constructed with the Cash Flow Cushion™ having a coefficient dependent on the values of the other variables because it will place greater importance on the Cash Flow Cushion™ in levered scenarios. This construct is helpful because the Cash Flow Cushion™ should have the fewest false positives of any of the main elements. However, the Cash Flow Cushion™ is also subject to analyst forecasts, which can contain modeling errors. In situations deemed "safe" by the  $DD_D$ ,  $SS_D$ , and  $BR_D$ , the Cash Flow Cushion™ will have less weight in order to minimize the effect any possible modeling errors. We expect the Cash Flow Cushion™ to have fewer false positives because it describes the true forecasted cash inflows and outflows of a company. Since these cash flows represent the actual ability of a firm to repay its obligations, the Cash Flow Cushion™ should be the best absolute predictor of financial distress in our arsenal of scores.

The four pillars are transformed into scores from 1 to 10 (10 being worst) based on breakpoints calculated with historical distributions of each data point. For Distance to Default and the Solvency Score™, we used an entire business cycle worth of data. While this was not possible with the Business Risk and Cash Flow Cushion™ scores, we have set static breakpoints. Because the breakpoints are relatively static, the scores are not relative measures. At any particular time, significantly more than 10% of companies could have the same score for any particular component.

The credit score resulting from the above equation is mapped according to the table below to its corresponding credit rating.

Credit Score	Credit Rating	Description
[16-23]	AAA	Extremely low default risk. Issuers rated AAA typically operate wide moat, low uncertainty businesses and can easily cover all outstanding maturities with cash on hand and one year's worth of free cash flow.
[23-61]	AA	Very low default risk. Issuers rated AA tend to be wide or narrow moat companies with low to medium uncertainty and a Morningstar Cash Flow Cushion™ that affords a very wide margin of safety against adverse developments.
[61-96]	A	Low default risk. Issuers rated A typically include wide or narrow moat companies with medium to high uncertainty and a Morningstar Cash Flow Cushion™ that affords a wide margin of safety against adverse developments.
[96-142]	BBB	Moderate default risk. Issuers rated BBB typically include narrow or no moat companies with medium to very high uncertainty and a Morningstar Cash Flow Cushion™ that affords a modest margin of safety against deteriorating business conditions.
[142-174]	BB	Above average default risk. Issuers rated BB typically include no moat companies with high to very high uncertainty and a Morningstar Cash Flow Cushion™ that affords a minimal margin of safety against deteriorating business conditions.
[174-199]	B	High default risk. Issuers rated B typically include no moat companies with very high uncertainty and a Morningstar Cash Flow Cushion™ that indicates significant dependence on favorable business conditions.
Assigned by Committee	CCC	Currently very high default risk. Issuers rated CCC typically include no moat companies with very high uncertainty and a Morningstar Cash Flow Cushion™ that indicates extreme dependence on favorable business conditions to avoid default or significant capital restructuring.
Assigned by Committee	CC	Currently extreme default risk
Assigned by Committee	C	Imminent payment default
Assigned by Committee	D	Payment default

The final credit score can be accepted by the analyst, or the analyst can propose an adjustment to the modeled score to the credit committee. The credit committee will review all cases where the analyst disagrees with the modeled credit rating to bring consistency to the rating process. This will ensure that the analyst's arguments for differing from the prescribed score are sound.

## Procedures for Assigning Final Issuer Credit Ratings

Our process for assigning final credit ratings is as follows:

1. The analyst derives the preliminary issuer credit rating based on our proprietary credit rating methodology.
2. The analyst takes the preliminary issuer credit rating to the Credit Rating Committee for sign-off. The analyst can argue for a higher or lower rating than the preliminary rating, but the ultimate decision rests with the Credit Rating Committee.
3. At least once per quarter, the analyst updates the preliminary credit rating. If the preliminary rating indicates that a change in the issuer credit rating is warranted, or if the analyst has other information that he/she feels warrants a change in the credit rating, the analyst meets with the Rating Committee.
4. All changes to issuer ratings need to be approved by the Credit Rating Committee.

## Rating Assignment for Debt Issuers with Estimated Time to Default

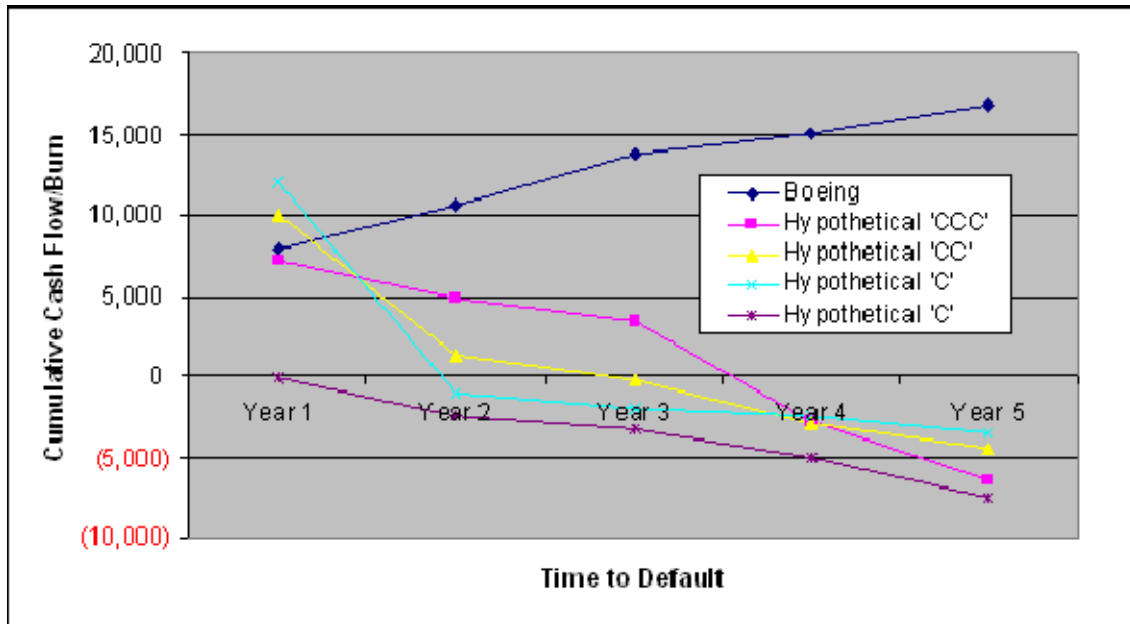
By Brian Nelson, CFA

In the chart on the next page, we outline the conceptual framework the Credit Rating Committee uses, in conjunction with additional analysis, to support the ratings it assigns to non-investment grade debt, where a timing element is considered.

The approach measures a firm's timing to default, in years, and starts with liquid cash on hand and then phases in adjusted free cash flow generation and debt-like cash maturities on an annual basis during the next five years. At its core, the framework represents a basic cash burn analysis expanded to a five-year horizon. The information required to do this analysis across our coverage list is embedded in the Cash Flow Cushion™.

AAA	Extremely Low Default Risk
AA	Very Low Default Risk
A	Low Default Risk
BBB	Moderate Default Risk
BB	Above Average Default Risk
B	High Default Risk
CCC	Currently Very High Default Risk
CC	Currently Extreme Default Risk
C	Imminent Payment Default
D	Payment Default

Essentially, when cumulative cash flow/burn crosses 0, the firm may be exposed to potential default if it is unable to secure additional financing at that time. If a firm's cumulative cash flow/burn crosses 0 during Years 1-2 there may be support for a 'C' rating, during Year 3 a 'CC' rating, and during Years 4-5 a 'CCC' rating. The Credit Rating Committee may also consider other firm-specific criteria in assessing the timing to default and assigning ratings CCC through C.



# Appendices

## Appendix A: Morningstar Solvency Score™ Model Development

By Warren Miller

In our effort to build a ratio-based metric with superior ability to predict bankruptcy than the Altman Z-Score, we decided to use a hazard logistic regression model. Such a model gave us the flexibility to conduct our analysis using an entire business cycle worth of data, and perform multivariate analysis using a stepwise variable selection method.

Specifically, the dependent variable we chose for our analysis was a binary [0 or 1] variable that signified whether a company had gone bankrupt within a year subsequent to the date corresponding to the financial ratios we used as our independent variables.

As practicing investment analysts, we are familiar with several conventional financial ratios that are relevant to the financial health of an industrial company. These ratios, shown in Table 1 below served as the basis for the independent variables in our regression model. However, while financial ratios equalize companies of different sizes, there are data challenges with using conventional ratios in a regression analysis.

Ratios such as these are not immediately useful in a regression analysis. Several can become negative, and at the point where crossing from positive to negative territory, the magnitude of the ratio switches significance. E.g. when Total Liabilities/Total Equity is slightly negative, it is far worse than when it is largely negative – effectively thwarting the lower-is-worse ordinality of the ratio. To combat this effect in our ratios, we transformed them, in some cases using different accounting values that due to identities such as  $Assets = Liabilities + Equity$  conveyed the same information, yet suffered no ordinality issues. Lastly we transformed each ratio from its continuous ratio form to a discrete percentile form using breakpoints empirically calculated with 10 years of historical ratio data.

We fit our regression using approximately 75% of our available data so as to retain 25% of the bankruptcies for out-of-sample performance testing purposes. The out-of-sample performance of our regression model, known as the Morningstar Solvency Score™ are shown in the Backtesting Appendix. The equation resulting from our regression is the Morningstar Solvency Score™ shown in Equation 1 of the Morningstar Solvency Score™ section of this document.

TotalAssets/WorkingCapital
TotalAssets/RetainedEarning
TotalAssets/EBIT
TotalLiabilities/TotalEquity
TotalAssets/TotalRevenue
TotalDebt/TotalCapital
TotalDebt/TotalEquity
NetDebt(operating cash)/TotalCapital
NetDebt(including excess cash)/TotalCapital
TotalDebt/EBITDA
TotalAssets/TotalEquity
TotalRevenue/EBIT
TotalRevenue/EBITDA
TotalRevenue/NetIncome
TotalRevenue/FreeCashFlow(OCF-Capex)
TotalDebt/FreeCashFlow(OCF-Capex)
CurrentRatio
QuickRatio
CashRatio
InterestExpense/EBIT
InterestExpense/EBITDA
ROIC
ROE
ROA
CashCushion

**Table 1:** Initial Ratios

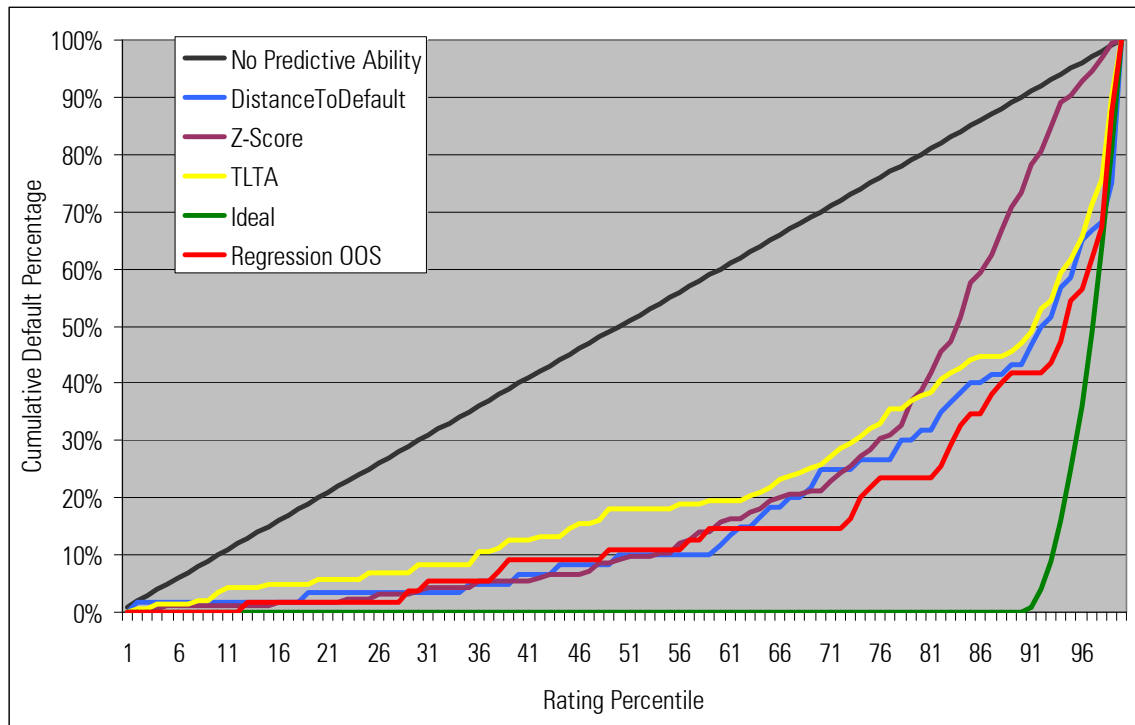
## Appendix B: Backtesting

By Warren Miller

In order to test the performance of the Distance to Default and Solvency Score™ components of our credit rating, we generated each measure for thousands of historical date-company records over the last ten years. We matched these date-company records to a list of company-date records corresponding to chapter 7 and chapter 11 public company bankruptcy records. We transformed our ratings from continuous numbers to a discrete percentile buckets to improve comparability of results. In all cases, a higher percentile rating implies a more “dangerous” company.

### Ordinal Results

Our bankruptcy-matched data set allowed us to generate the cumulative accuracy profile shown in Figure 1 which depicts each model’s ordinal ability to sort “safe” companies from “dangerous” ones. We’ve also included the Altman Z-Score and a simple univariate model with one ratio, Total Liabilities to Total Assets (TLTA).



**Figure 1:** Cumulative Accuracy Profile with 1-Year Bankruptcy Time-Horizon

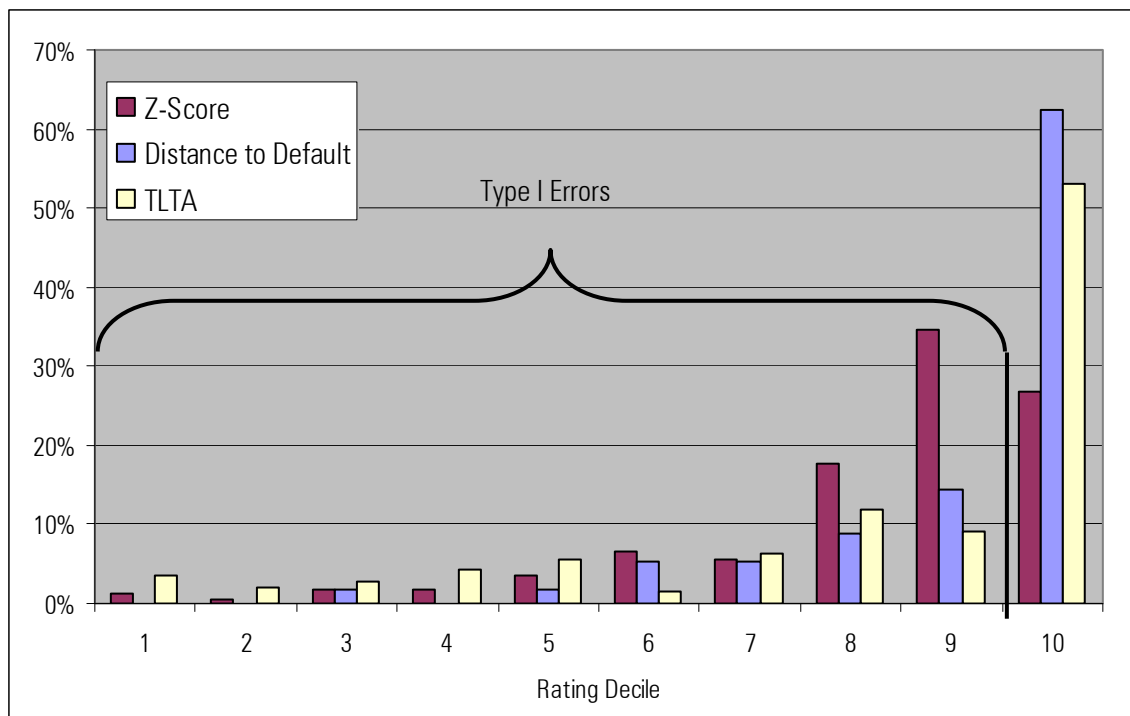
In a cumulative accuracy profile, the more concave a particular curve is, the more ordinal ability that particular model has. For example, a model with no predictive ability would be the straight 45 degree line shown in Figure 1. We can see that the Distance to Default and Solvency Score™ outperform both the Z-Score and TLTA model over nearly all rating percentiles. In particular, the Distance to Default and Solvency Score™ do particularly well in “dangerous” situations as opposed to the Altman Z-Score which has a convex curve between its 80<sup>th</sup> and 100<sup>th</sup> percentiles. The entire cumulative accuracy profile can be summed up by each curve’s Accuracy Ratio. The Accuracy Ratio is the ratio of the area between the No Predict and relevant

model's curve to the area between the No Predict and Ideal curve. The Accuracy Ratios of all 4 models are shown in Figure 2.

	Accuracy Ratio
Ideal	1.00
Solvency Score	0.74
Distance to Default	0.70
TL/TA	0.60
Z-Score	0.60
No Predict	0.00

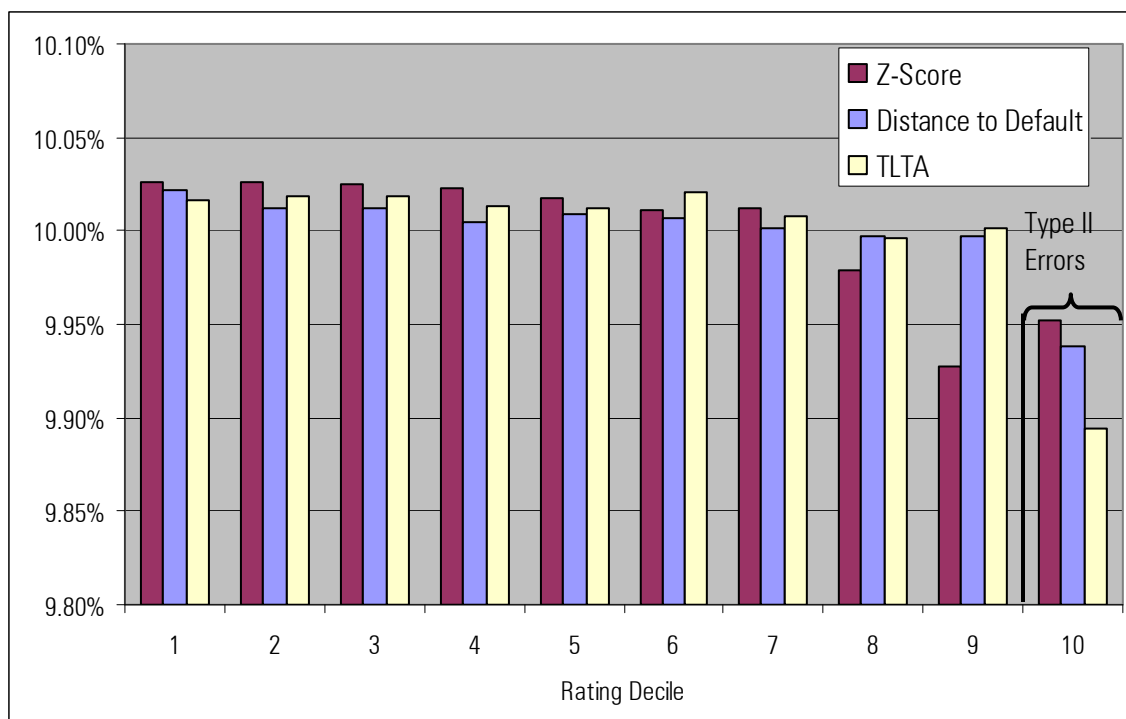
**Table 1:** Accuracy Ratios for Models with 1-Year Bankruptcy Time Horizon

### Cardinal Results



**Figure 2:** Rating Distribution of Companies Filing for Bankruptcy Within 1-Year (Type I Error)

Ideally, companies that go bankrupt within one year should all be in the 10<sup>th</sup> decile of a rating system, with no soon-to-be bankrupt companies rated in the 9<sup>th</sup> decile or below. Figure 2 shows the occurrence of false-negatives, or how often each model says a company is safe, when in fact, it is not. Graphically, we can see that Distance to Default outperforms TLTA which outperforms the Z-Score.



**Figure 3:** Rating Distribution of Companies Not Filing for Bankruptcy Within 1-Year (Type II Error)

Figure 3 is the inverse of Figure 2. It shows the occurrence of false-positives, which are clearly quite prevalent in all three models. Ideally the graph, which shows the rating distribution for companies that did not go bankrupt within one year, would have the largest percentage of companies rated in the 1<sup>st</sup> decile, and decrease as the decile increases. We do see this relationship slightly; however, the distribution of ratings is close to uniform as all deciles are within one percentage point of each other for all three models.

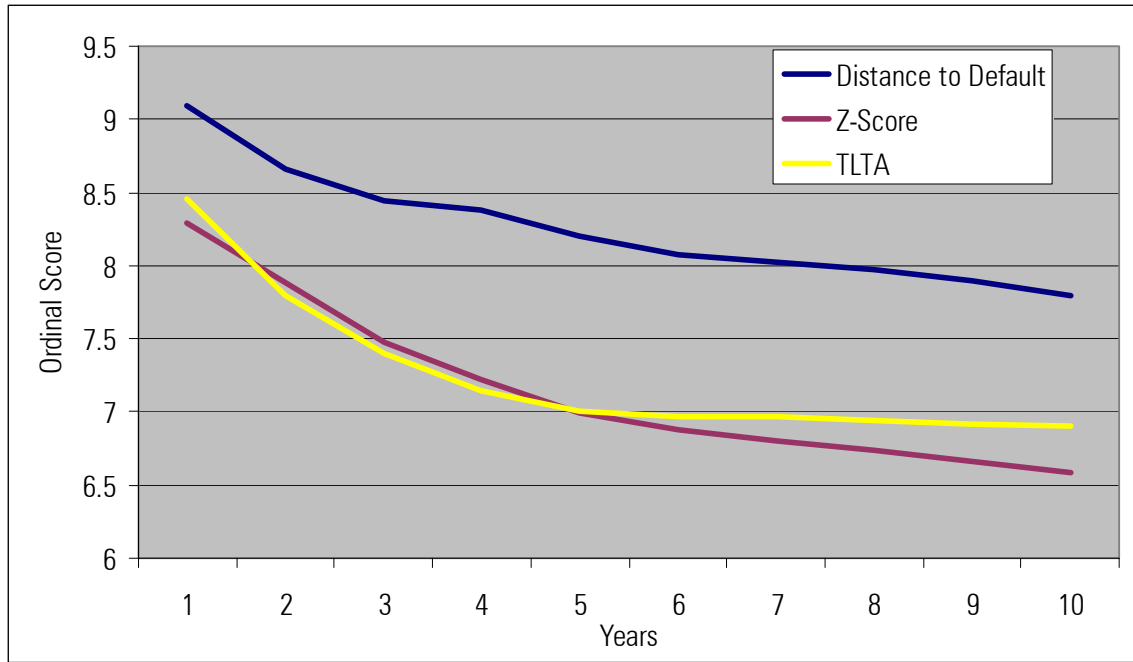
	Average Rating Before Default	Default Rate of Top Quintile
Distance to Default	9.1	0.5%
Z-Score	8.3	0.6%
TATL	8.2	0.8%

**Table 2:** Cardinal Accuracy Measures

Of the three models, Distance to Default proved to be most predictive of bankruptcy in absolute terms. On average, the most recent Distance to Default decile before a bankruptcy event was 9.1. In addition, it had the lowest occurrence of bankruptcies in its best rated quintile of companies. The Z-Score placed second in both measures, followed by TLTA.

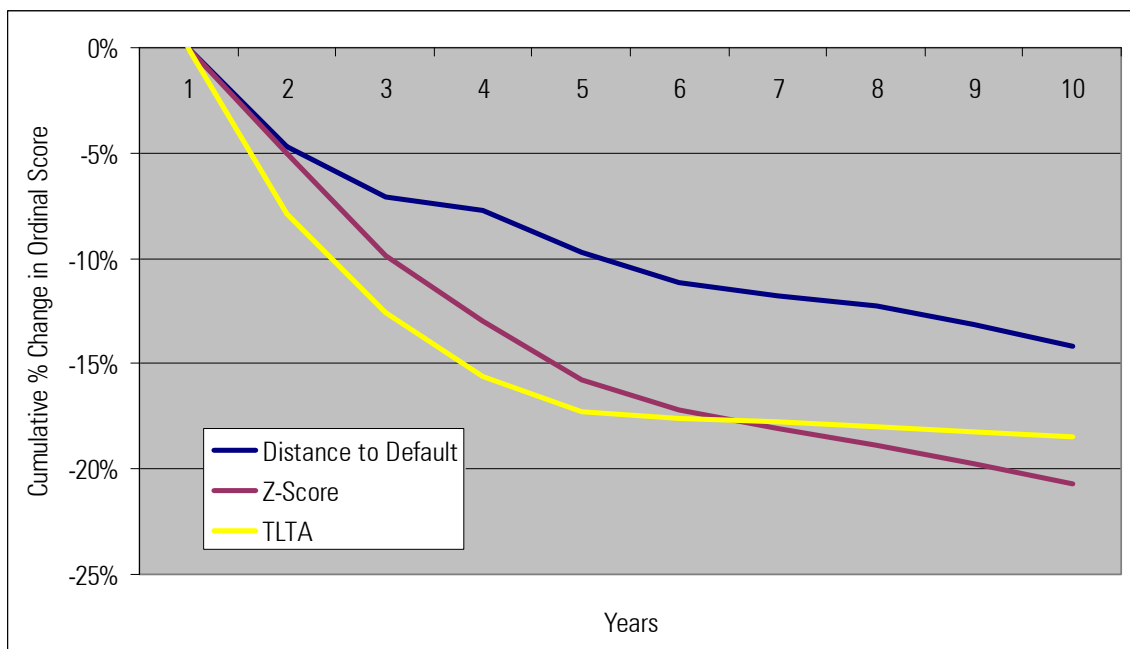
## Durability Results

As time passes, the information contained in the inputs of any particular model becomes stale. As a result, it is reasonable to expect that the ordinal ability of any bankruptcy prediction model would decay as the allowable time-horizon for bankruptcy lengthens. Figure 4 shows the ordinal score of all three models over one to ten year bankruptcy time-horizons. The ordinal score is an alternative to the Accuracy Ratio and is meant to describe the model's relative predictive abilities. It can take on a value from 1 (least ordinal ability) to 10 (most ordinal ability).



**Figure 4:** Ordinal Score Over All Bankruptcy Time Horizons Between 1 and 10 Years

Figure 4 shows that Distance to Default has superior ordinal ability over all bankruptcy time horizons than the Z-Score or TLTA model. Over short (<2-year) and long (>5-year) time horizons the TLTA model is superior to the Z-Score model.

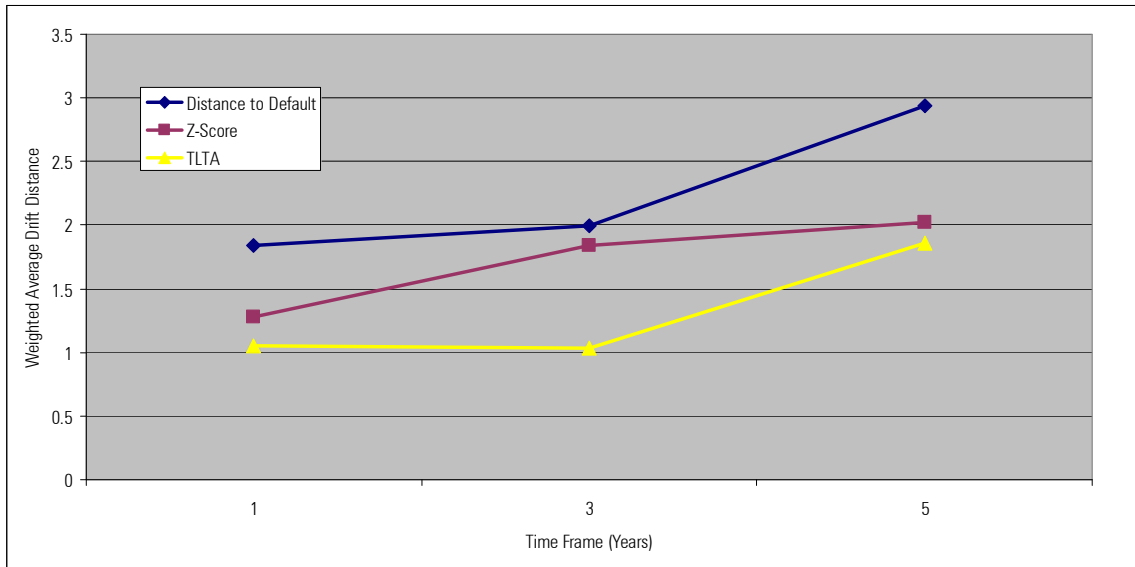


**Figure 5:** Ordinal Score Decay Over All Bankruptcy Time Horizons Between 1 and 10 Years

The cumulative change in ordinal score in Figure 5 shows us how durable of an ordinal rating each model generates. Distance to Default generates the most durable ratings because its ordinal score decays the slowest of the three models. Initially the TLTA model decays at a rapid rate, but its asymptotic slope levels off over longer time periods allowing it to outperform the Z-Score in rating durability beyond seven years.

## Drift Results

Many users of credit scoring systems benefit from stable ratings. Regulatory or client requirements often require debt investors to maintain a certain portfolio allocation of “safe” credit instruments. For ratings to constantly flux from “safe” to dangerous would cause increasing portfolio management costs to such credit market investors through increased transactions and portfolio monitoring. We measured rating stability with our measure known as Weighted Average Drift Distance which describes the average number of deciles a particular rating will drift over a given time-horizon. It can take on values from 0 (least drift, most stable) to 9 (most drift, least stable)



**Figure 6:** Weighted Average Drift Distance Over 1-, 3- and 5-Year Time Horizons

Figure 6 shows Distance to Default is the least stable rating system, followed by the Z-Score which is followed by TLTA. This is expected, since market-based model inputs should, in most cases, be more volatile than accounting-based inputs, and Distance to Default relies the most on market-based inputs. One of the five Z-Score ratios is also market based. TLTA is purely accounting based, and as it describes a company’s capital structure, it is probably one of the more stable accounting-based ratios available. Large changes in the TLTA ratio for most firms would probably be the result of an intentional shift in management decision-making rather than a fluctuation of business conditions.

## Appendix C: Regulatory Score for Utilities

By Travis Miller

Many utilities have unique cash flow characteristics and risk profiles because of federal and state regulatory oversight that seeks to maintain efficient operation of energy infrastructure. Regulators often grant utilities monopoly ownership of the infrastructure assets. In return, those utilities must set customer rates at levels that regulators or legislators determine during legal proceedings. Through this compact, both the utilities and regulators have shared incentives to keep the infrastructure operating efficiently to serve customers and constituents. This includes compensating capital providers with adequate returns.

To capture the regulatory effect on cash flow and bankruptcy risk, we implement a Regulatory Score in place of the Solvency Score™ for most utilities with these operating characteristics. The Regulatory Score is an absolute measure ranging from 1 (best) to 10 (worst) that measures cash flow certainty, ability to achieve sufficient returns on capital, and general political support. It is utility-specific, not jurisdiction-specific.

Four subscores roll up into our overall Regulatory Score.

1. The first of four Regulatory Score components measures the spread between allowed returns on equity and market costs for investment-grade corporate utility debt. The higher this regulatory equity risk premium, the more substantial an earnings cushion lenders typically enjoy.
2. The second component measures a utility's ability to recover fuel costs, most utilities' largest operating cost, in a timely manner.
3. The third component measures a utility's ability to adjust rates without full regulatory proceedings. A higher level of automatic rate adjustments typically reduces regulatory risk, improves the consistency of returns on capital and improves cash flow by reducing the short-term financing required between cash outflows for expenses and cash inflows from rate recovery.
4. The final component captures our analysts' perception of whether the current and historic relationship between a utility and its regulators suggests any regulatory biases that would favor ratepayers relative to utility capital providers or vice versa.

We weight the four components equally to produce the final Regulatory Score.

# Morningstar's Standard Adjustments to Key Credit-Relevant Ratios for Non-Financial Corporations

## Introduction

Morningstar's credit analysts make a number of adjustments to financial data in order to better reflect the underlying economics of companies and to improve comparability across peers in specific industries. Although our analysts may make other adjustments for capitalized interest, securitizations, and the value of inventory (LIFO vs. FIFO), we make standardized adjustments to credit-relevant ratios for the following items:

<b>Morningstar's Standardized Adjustments to Forward-Looking Ratios</b>	
Consideration	Reason
Underfunded Defined Benefit Pension Plans	To recognize as debt the underfundedness of a pension plan (as measured by the excess of the projected benefit obligation over the fair value of plan assets). Pension assets and liabilities recognized under GAAP are excluded. We model only the service cost of net periodic benefit cost in earnings before interest and taxes and subsequently cash flow from operations and remove the cash contributions to pensions from cash flow from operations.
Operating Leases	To capitalize operating leases to reflect their economic substance as debt, applying a standardized 8x multiple to forecasted rent expense. We also include the corresponding creation of fixed assets in the calculation of total assets and return on invested capital. Rent expense is reclassified into depreciation and interest expense, the allocation of which is determined by the credit analyst's assumption of the remaining useful life of leased assets.
Employee Stock Compensation	To remove the tax benefit from a firm's cash flow from operations. We model stock option expense in earnings before interest and taxes.
Research and Development	To recognize the long-term benefits of R&D as a research asset strictly for our calculation of a company's return on invested capital. We do not adjust our calculation of the firm's total assets for this consideration.
Unusual and Non-recurring Items	To reflect the core operating performance of the underlying business by removing one-time charges in the calculation of net income.
Hybrid Securities	To treat trust preferred as debt; we generally treat preferred stock as equity.

## Definition of Credit-Relevant Ratios

Although this list is not all-inclusive, below we define the ratios adjusted for the above items, where appropriate.

### Balance Sheet Strength

Total Debt to Book Capital

$$\frac{LTDebt + STDebt + PensionUnderfundedness + CapitalizedLeaseObligations, net}{Sh.holders' Equity + NetPensionLiab - PensionUnderfundedness + PreferredStock + LTDebt + STDebt}$$

Total Debt to Book Equity

$$\frac{LTDebt + STDebt + PensionUnderfundedness + CapitalizedLeaseObligations, net}{Shareholders' Equity + NetPensionLiab - PensionUnderfundedness}$$

Net Debt to Book Capital

$$\frac{LTDebt + STDebt + PensionUnderfundedness + CapLeaseObl, net - Excess \& OpCash}{Sh.holders' Equity + NetPensionLiab - PensionUnderfundedness + PreferredStock + LTDebt + STDebt}$$

Total Debt to EBITDA

$$\frac{LTDebt + STDebt + PensionUnderfundedness + CapitalizedLeaseObligations, net}{EBIT + Depreciation + Amortization + Impairment \& RestructuringCharges}$$

Total Debt to EBITDAR<sup>1</sup>

$$\frac{LTDebt + STDebt + PensionUnderfundedness + CapLeaseObligations, net}{EBIT + Depreciation + Amortization + Impairment \& RestructuringCharges + RentExpense}$$

Total Assets to Book Equity

$$\frac{TotalAssets(includingCapitalizedLeaseObligations, net) - PensionAsset}{Shareholders' Equity + NetPensionLiab - PensionUnderfundedness}$$

Total Firm Value to Total Debt<sup>2</sup>

<sup>1</sup> The denominator also equals the following: EBIT + depreciation + amortization + lease-related depreciation + lease-related interest.

<sup>2</sup> Please view Morningstar's proprietary discounted cash flow model for our calculation of Total Firm Value.

## Profitability

Operating Margin

$$\frac{EBIT + Lease\ related\ Interest}{Revenue}$$

EBITDA Margin

$$\frac{EBIT + Depreciation + Amortization + Impairment \& Re\ structuring\ Charges}{Revenue}$$

EBITDAR Margin<sup>3</sup>

$$\frac{EBIT + Depreciation + Amortization + Impairment \& Re\ structuring\ Charges + Rent\ Expense}{Revenue}$$

Return on Invested Capital (with Goodwill)<sup>4</sup>

Return on Equity

$$\frac{Net\ Income, \ excluding\ charges}{Average(Shareholders' \ Equity + Net\ Pension\ Liab - Pension\ Underfundedness)}$$

Return on Assets

$$\frac{Net\ Income, \ excluding\ charges}{Average[Total\ Assets(including\ Capitalized\ Lease\ Obligations, \ net) - Pension\ Asset]}$$

## Cash Generation

Free Cash Flow Margin

$$\frac{Cash\ Flow\ From\ Operations - Capital\ Expenditures}{Revenue}$$

Enterprise Free Cash Flow Margin<sup>5</sup>

Free Cash Flow to Total Debt

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<sup>3</sup> Please see footnote 1.

<sup>4</sup> Please view Morningstar's proprietary discounted cash flow model for our calculation of ROIC.

<sup>5</sup> Please view Morningstar's proprietary discounted cash flow model for our calculation of enterprise free cash flow.

$$\frac{\text{CashFlowFromOperations} - \text{CapitalExpenditures}}{\text{LTDebt} + \text{STDebt} + \text{PensionUnderfundedness} + \text{CapitalizedLeaseObligations, net}}$$
  
Free Cash Flow to Cash Interest

$$\frac{\text{CashFlowFromOperations} - \text{CapitalExpenditures}}{\text{CashInterest}}$$

Enterprise Free Cash Flow to Total Debt (please view footnote 2)

Enterprise Free Cash Flow to Cash Interest (please view footnote 2)

### Liquidity and Coverage

Current Ratio

$$\frac{\text{TotalCurrentAssets}}{\text{TotalCurrentLiabilities}}$$

Quick Ratio

$$\frac{\text{ExcessCash} + \text{OperatingCash} + \text{Accounts Receivable}}{\text{TotalCurrentLiabilities}}$$

Cash Ratio

$$\frac{\text{ExcessCash} + \text{OperatingCash}}{\text{TotalCurrentLiabilities}}$$

EBIT to Interest Expense

$$\frac{\text{EBIT} + \text{LeaserelatedInterestExpense}}{\text{InterestExpense} + \text{LeaserelatedInterestExpense}}$$

EBITDA to Interest Expense

$$\frac{\text{EBIT} + \text{Depreciation} + \text{Amortization} + \text{Impairment \& Re structuringCh arg es}}{\text{InterestExpense}}$$

EBITDAR to Adjusted Interest Expense

$$\frac{\text{EBIT} + \text{Depreciation} + \text{Amortization} + \text{Impairment \& Re structuringCh arg es} + \text{RentExpense}}{\text{InterestExpense} + \text{LeaserelatedInterest}}$$