The Z-Metrics™ Methodology For Estimating Company Credit Ratings And Default Risk Probabilities

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Contents

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Credit Conditions Background

Since mid-2007, most of the world has been going through a period of extreme financial and economic turmoil. The financial sector's problems have negatively impacted real economic growth, asset prices, unemployment levels and individual firm default and bankruptcy rates. High-yield bond and leveraged loan default rates in 2009 were near or surpassed record levels in the United States[1] and Europe and the outlook for the next several years is extremely uncertain and precarious.

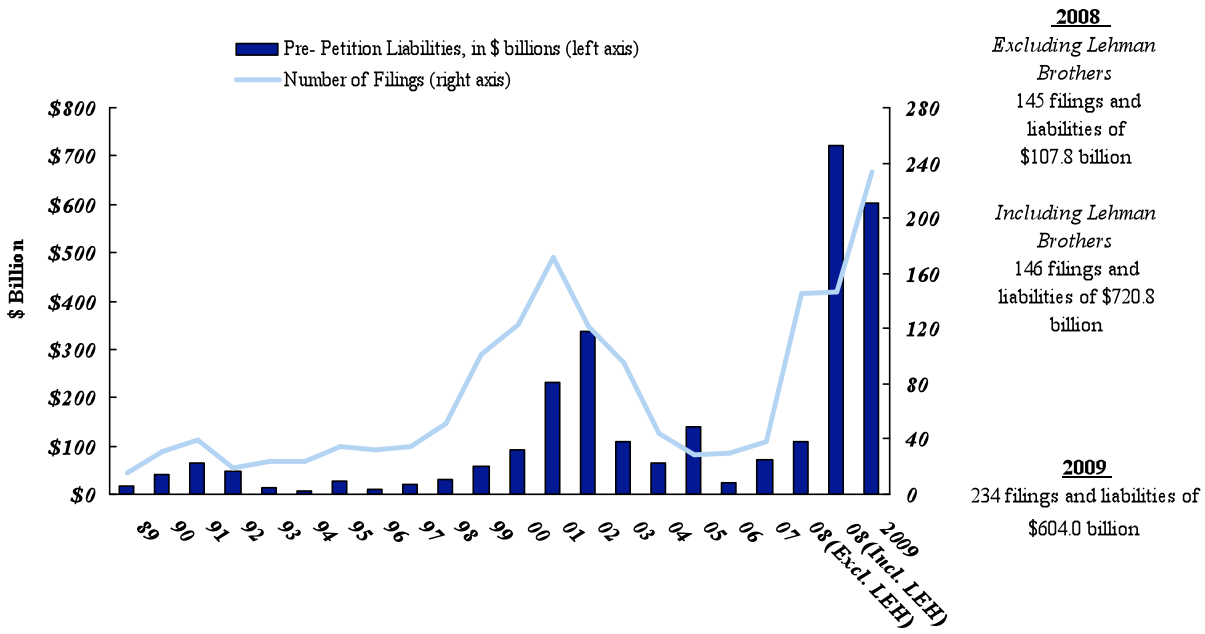
In the United States in 2009, over 230 firms with liabilities of at least $100 million filed for Chapter 11 bankruptcy protection with combined liabilities of over $600 billion. Forty-three (43) of these bankruptcy filings involved firms with at least $1 billion in liabilities, with companies like General Motors Corp., the CIT Group, Chrysler, LLC, Capmark Financial Group, General Growth Properties, Charter Communications, Lyondell Chemical Co., R. H. Donnelley Corp. and Nortel Networks, each with more than $10 billion in liabilities "leading" the way.[2] Not counting the impact of the mammoth Lehman Brothers bankruptcy in 2008, 2009 was easily the highest bankruptcy year ever in terms of Chapter 11 liabilities (Figure 1).

[1] Moody's issuer-denominated high-yield bond default rate peaked at over 13% in 2009, while Altman's dollar denominated rate was 10.74%, the second highest in the history of the high-yield bond market. S&P's leveraged loan default rates were at record levels near year-end 2009.

[2] For a complete list of Chapter 11 bankruptcies and corporate defaults, see E. Altman & B. Karlin, "Defaults and Returns in the High-Yield Bond Market Report: The year 2009 in Review," NYU Salomon Center Special Report, February 2010.

FIGURE 1

Total Filings And Liabilities* Of Companies Filing For Chapter 11 Protection **1989 - 2009**



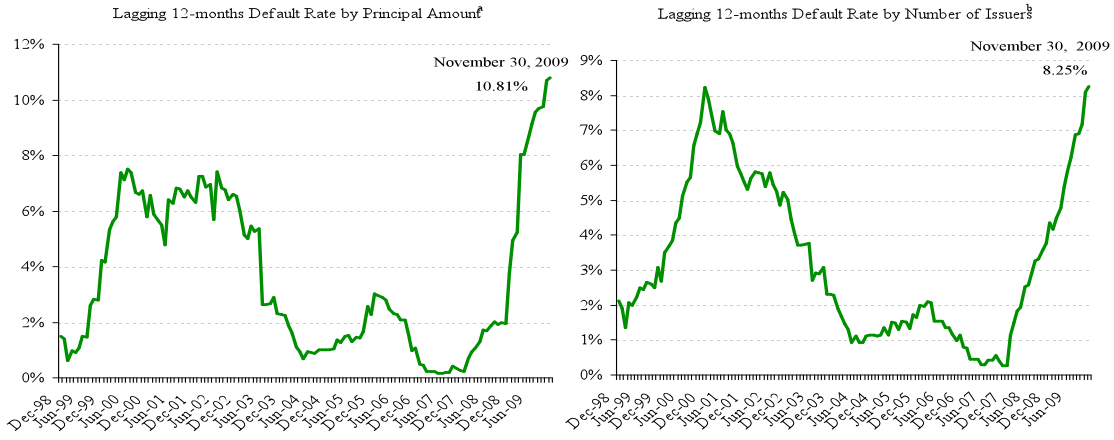
*Minimum $100 million in liabilities

Source: NYU Salomon Center Bankruptcy Filings Database

Default rates on U.S. and Canadian high-yield bonds and leveraged loans, despite their moderation in the later part of the year, reached double digits in 2009, with the latter loan default rate a record year (Figure 2). For high-yield bonds, it was the fourth (essentially the fifth if you include 2001's 9.8%), year in the modern high-yield market that defaults exceeded 10% (Figure 3), indicating the fairly continuous need for credit institutions and other investors to carefully monitor the financial outlook and credit-worthiness of industrial and financial enterprises. The importance of credit risk assessment and especially the estimation of default probabilities has relevance not only to asset prices in credit and debt markets, but also in equity and in many types of derivative markets, particularly the credit default swap market.

Figure 2

Lagging Twelve-Month Leveraged Loan Default Rate by Principal Amount & Number of Issuers



[a]**Default rate** is calculated as the amount defaulted over the last twelve months divided by the amount outstanding at the beginning of the twelve-month period. [b]**Default rate** is calculated as the number of defaults over the last twelve months divided by the number of issuers in the Index at the beginning of the twelve-month period.

Source: S&P LCD

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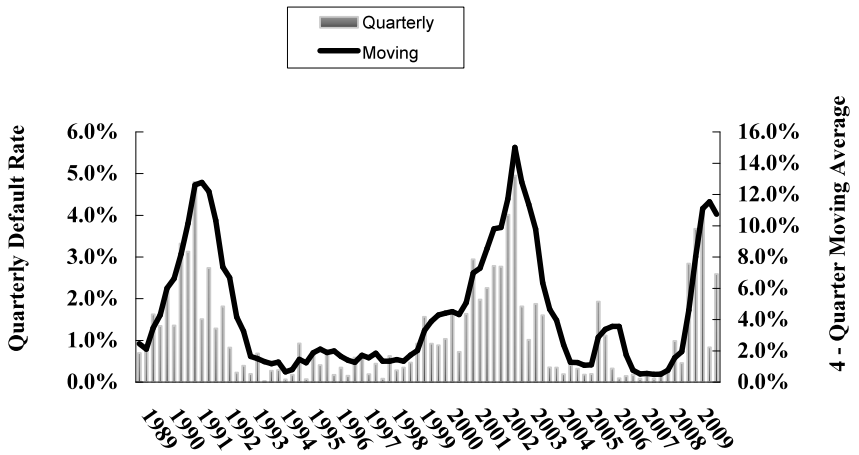
The recent economic turmoil is not limited to firms in the United States and Canada, as worldwide problems were evident elsewhere, especially in such countries as the UK, Spain, Ireland, Greece, other Western and Central European countries, and the Middle-East. Additionally, other recessions and crises in the recent past have severely impacted enterprises in Asia and Latin America, as well as most other developed and emerging economies. Highlighting this point, a recently released (October 2009) stress-test from the *Committee of European Banking Supervisors* indicates that large European banks could face credit losses of €400 billion in 2009 and 2010. Given these concerns, credit risk assessment is a mainstream necessity for market professionals and firms among the world's economies.

FIGURE 3

QUARTERLY DEFAULT RATE AND FOUR QUARTER MOVING AVERAGE
1989 - 2009



Source: Authors' Compilations

Our Z-Metrics™ Approach

To address the assessment of credit risk of companies, RiskMetrics Group has partnered with Dr. Edward Altman of NYU's Stern School of Business and Dr. Herbert Rijken of the Vrije University of Amsterdam. The Z-Metrics methodology is the result of combining RiskMetrics' thought leadership in market risk and credit risk with Altman and Rijken's vast experience in evaluating the creditworthiness of corporations, which includes the development of the groundbreaking "Z score" and their more recent analysis of the accuracy and timing of rating agencies' performance[3].

Our objective is to assess the credit risk of non-financial enterprises by developing up-to-date credit scoring and probability of default metrics for enterprises both public and private, large and small, on a global basis. Starting with a large sample of firm data over the

[3] Altman Edward I., Rijken Herbert A., 2006, *A Point-in-Time Perspective on Through-the-Cycle Ratings*, Financial Analysts Journal, January/February, Vol. 62, No. 1 : pp. 54-70

period 1989-2009, involving more than 260,000 quarterly and annual firm financial statements and associated market prices and macroeconomic data observations, we have utilized a multivariate logistic regression structure to construct our models. We used the criterion of a "credit event," which is defined here to be either a formal default or bankruptcy legal event, whichever comes first, to segregate firms into cohorts. Those firms which have had a credit event within a given timeframe (i.e., 1 year or 5 years) were assigned to the "distressed" or "credit event" group; those that did not incur a credit event were assigned to the non-distressed group. It is based on these cohorts that we have built a model to predict performance.

We emphasize that our results will be applicable across the complete spectrum of credit quality and ratings from the lowest to the highest default risk categories. The result is a robust model with high default/non-default classification and predictive accuracy. Whenever possible, we compare our output with publicly available credit ratings and existing models. The accuracy ratios and observed results on samples of individual defaulting firms using our new approach outperform existing methodologies in our analysis. Our user-friendly results will first be specified for relatively large (greater than 50 million USD in sales) non-financial firms in the U.S. and Canada and very soon (later 2010) to the UK and the rest of the world.

Objectives of our Z-Metrics™ Models

- To construct an accurate, logical and robust credit-scoring model based on large and representative samples of non-financial companies that have either suffered a serious negative credit event or have remained healthy.
- To assign a point in time probability of default (PD) over one-year and five-year horizons based on a firm's credit score.
- To assign our unique Z-Metrics credit rating, given the PD, to each firm representing the full spectrum of creditworthiness; one that is easily mapped to familiar credit terminology.
- To provide stressed PDs and ratings under various scenarios.

The credit scores, Z-Metrics credit ratings and probabilities of default will be available for the following populations:

- Large (greater than $50 million in sales) publicly-held firms in the U.S. and Canada
- Large, privately-held firms in the U.S. and Canada (based on data availability)
- Small publicly-held firms in the U.S. and Canada (available later in 2010)
- **Large and small firms outside the U.S. and Canada (available later in 2010). We expect, however, that our U.S. model will also be immediately applicable to publicly-held firms in most other developed nations.**

Variables Assessed

- We analyzed over 50 fundamental financial statement variables covering such performance characteristics as solvency, leverage, size, profitability, interest coverage, liquidity, asset quality, investment, dividend payout, and financing results.
- In addition to point-in-time measures, we analyzed the trends in many of the variables mentioned above.
- We also included equity market price and return variables and their volatility patterns, adjusted for market movements. These variables have typically been used in structural, distance-to-default measures.
- We supplemented firm fundamental measures with several macroeconomic measures to adjust for macro-stresses on the world's economies.
- In all cases, we carefully examined the complete distribution of variable values, especially in the credit-event sample. This enabled us to devise transformations on the variables to either capture the nature of their distributions or to reduce the influence of outliers. These transformations included logarithmic functions, first differences and dummy variables if the trends or levels of the absolute measures were positive/negative.

Sample Characteristics

- Our first model's original sample consisted of over 1,000 U.S. or Canadian non-financial firms that suffered a credit event ("credit event sample") and a control sample of thousands of firms that did not suffer a credit event, roughly a ratio of 1:15. After removing those firms with insufficient data, the credit event sample was reduced to 638 firms for our public firm sample and 802 observations for our private firm sample. Historically, about 50% of all bond defaults in the U.S. take place on the same date as the bankruptcy filing and about 50% precede the bankruptcy date, if there is a filing at all. Outside the U.S., a "Chapter-11" bankruptcy type of filing is a relatively rare event, although payment defaults on loans and bonds are more common.

- The credit-event date is either the default date or bankruptcy date, whichever occurred first. Some firms in our sample went bankrupt but did not have publicly-traded debt.

- The sample period covered 1989-2008. See Figures 4A and 4B for the breakdown of number of credit-event observations by year of incidence. Figure 4B's sample is used to compare our model with Agency ratings.

- The one-year (12 months) model is based on data from financial statements and market data approximately one year prior to the credit event and includes macroeconomic data. The five-year model includes up to five annual financial statements prior to the event, except we use quarterly data for trend variables in conjunction with market data for the same period. No macroeconomic variables are included in the five-year models.

- We utilized quarterly observations in our trend variables for up to five years prior to the credit-event or non-credit event dates. In total, we included over 260,000 observations with sufficient financial data available.

- For all of our fundamental financial ratio variables, we closely examined the distribution of values, especially for the credit-event sample. For example, we observe that the distribution of the variable interest/(earnings before interest and taxes) [interest/EBIT] for our bankrupt/default sample had two modal values, one positive from +2.0 to +4.0 times and one negative from -0.5 to -3.0 times (Figure 5). Note that the distributions are quite similar for both the first half and second half of the sample period. And, in the cases of the retained earnings/total assets variable [RE/TA] and the market value of equity/total liability variable [MV/LIB] for the entire sample, the distributions had some high positive and negative outliers suggesting logarithmic transformations to reduce outlier influence (Figure 6).

- Macro-economic variables are included to capture the time-series variation of default probabilities over time. Since most firms have a higher probability of default in stressed periods, e.g., at the end of 2008, we wanted to capture heightened or lower probabilities by examining such variables as GDP growth, unemployment, credit spreads, inflation, among others.

- Our final public Z-Metrics Model for large U.S./Canadian firms has 12 fundamental variables, including both static and trend measures plus two macroeconomic variables (the unemployment rate and the spread between high-yield bonds and 10-year U.S. Treasuries). For our "stressed" ratings and PDs, we examine two critical measures—equity price and earnings.

FIGURE 4A

Number of default and bankruptcy events by year used to estimate the Z-Metrics large firm credit scoring models.

	Z-Metrics public models				Z-Metrics private models			
year of event	all events	default events[1]	bankruptcy events[2]	default & bankruptcy events [3]	all events	default events[1]	bankruptcy events[2]	default & bankruptcy events [3]
1990	25	13	3	9	34	22	4	9
1991	30	19	0	11	38	25	0	13
1992	16	8	4	4	24	13	6	5
1993	12	5	3	4	16	8	4	4
1994	8	1	5	2	10	3	5	2
1995	14	5	3	6	20	8	3	9
1996	12	2	7	3	13	2	8	3
1997	13	3	3	7	16	8	4	4
1998	35	19	6	10	36	20	6	10
1999	48	28	6	14	56	32	7	17
2000	63	25	16	22	75	35	16	24
2001	105	42	24	39	128	60	24	44
2002	70	37	17	16	103	58	20	25
2003	50	20	15	15	70	37	15	18
2004	25	9	8	8	33	16	8	9
2005	18	6	2	10	20	6	2	12
2006	10	5	2	3	12	3	3	6
2007	8	4	4	0	12	8	4	0
2008	26	6	14	6	33	11	14	8
2009	50	12	22	16	53	15	21	17
total	638	269	164	205	802	390	174	239

1 Corporate bond default event without a bankruptcy filing at the same time. Often a bankruptcy filing is followed later.

2 A bankruptcy event in absence of a corporate bond default event.

3 A substantial fraction of all bankruptcy events coincides with a corporate bond default event.

Source: Altman NYU Salomon Center Default and Bankruptcy databases.

FIGURE 4B

Number of default and bankruptcy events by year used to compare Z-Metrics ratings with Agency ratings.

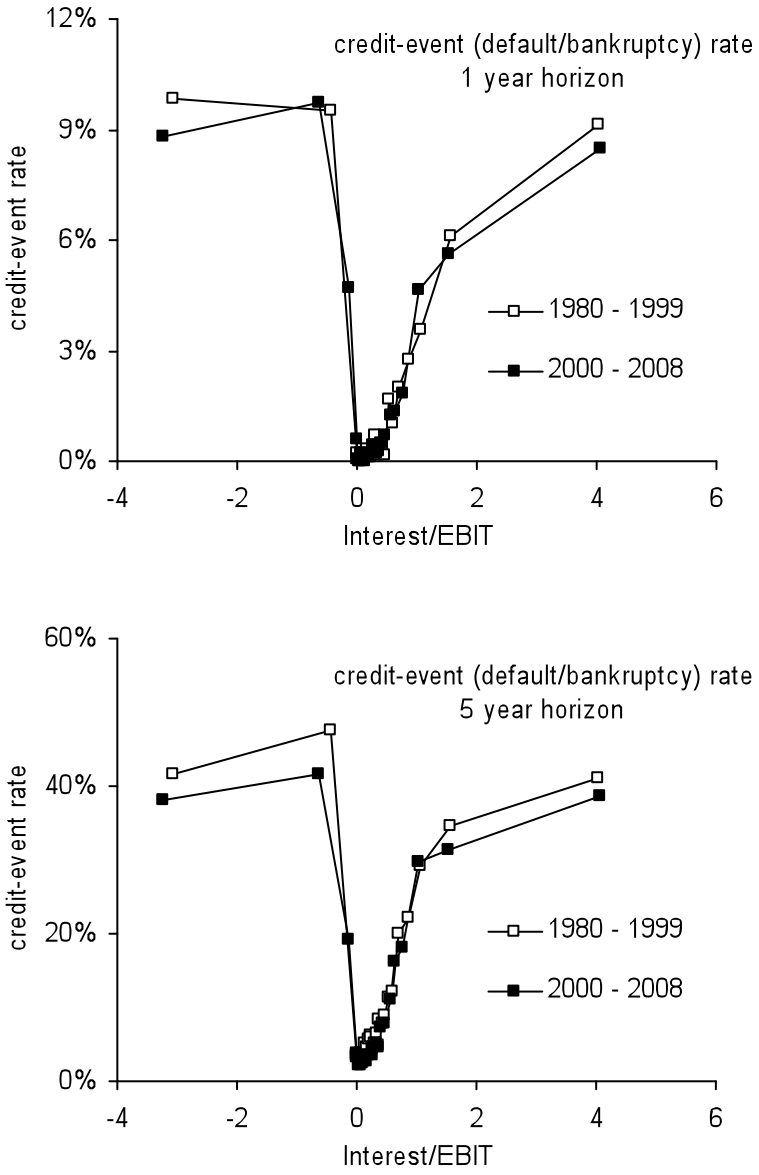
	Z-Metrics public models			Z-Metrics private models		
year of event	all events	only default events[1]	bankruptcy & default coincide	all events	only default events [1]	bankruptcy & default coincide
1990	21	13	8	26	18	8
1991	29	18	11	33	22	11
1992	9	6	3	15	11	4
1993	7	4	3	10	7	3
1994	2	0	2	3	1	2
1995	9	4	5	15	7	8
1996	5	2	3	5	2	3
1997	10	3	7	12	8	4
1998	26	18	8	27	19	8
1999	37	26	11	43	30	13
2000	40	23	17	51	32	19
2001	73	37	36	94	53	41
2002	45	33	12	69	52	17
2003	34	20	14	54	37	17
2004	17	9	8	23	14	9
2005	15	6	9	18	6	12
2006	6	3	3	9	3	6
2007	4	4	0	8	8	0
2008	13	5	8	20	10	10
2009	32	12	20	36	15	21
total	434	246	188	571	355	216

1 Corporate bond default event without a bankruptcy filing at the same time. Often a bankruptcy filing is followed later.

Source: Altman NYU Salomon Center Default and Bankruptcy databases.

FIGURE 5

Credit event rate as a function of Interest/EBIT for one year (Top panel) and five year (Bottom Panel) horizons

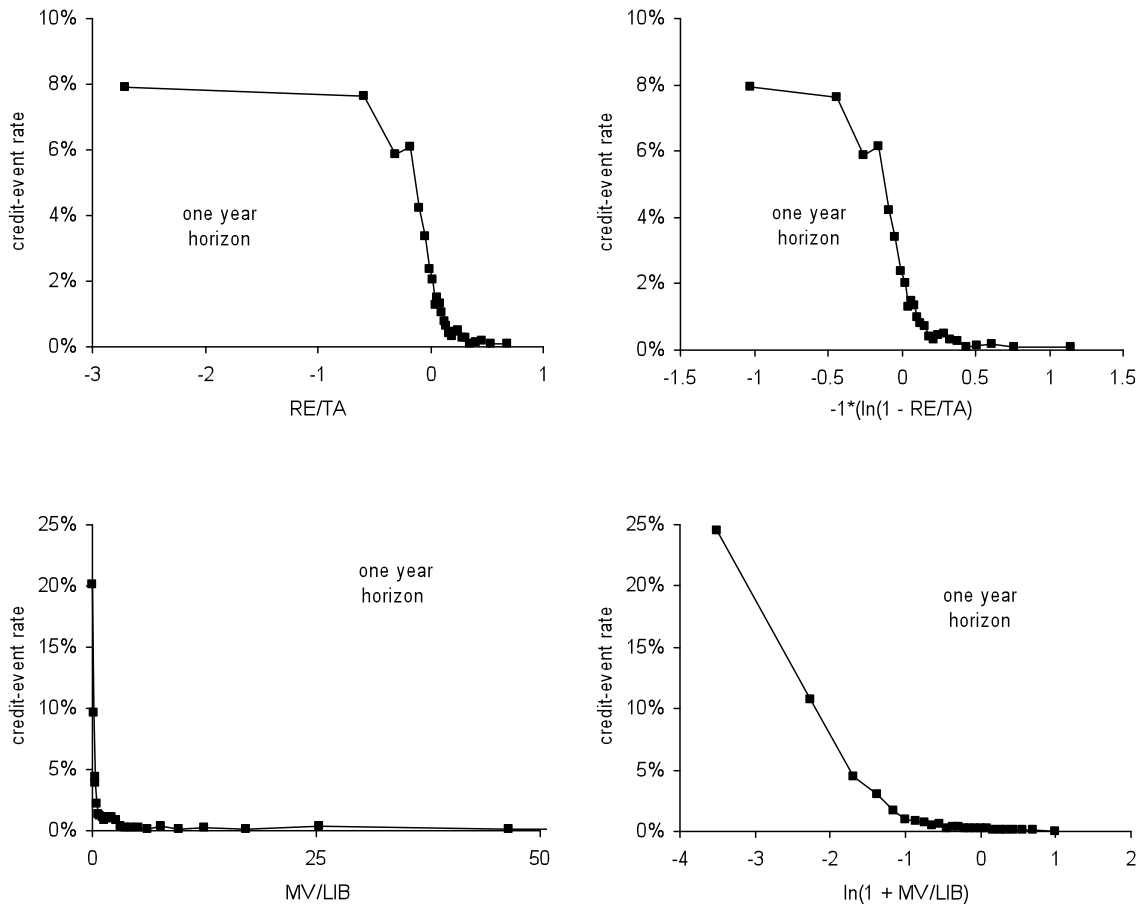


Sources: Altman NYU Salomon Center Default and Bankruptcy databases; COMPUSTAT.

Bankruptcy/default rates in period 1980 - 1999 are scaled by a constant to match the overall bankruptcy/default rates in period 2000 - 2008.

FIGURE 6

Impact of Log Transformations on the distribution of credit event rates for the variables RE/TA (Top Panel) and MV/LIB (Bottom Panel)



Sources: Altman NYU Salomon Center Default and Bankruptcy databases; COMPUSTAT.

Public and Private Firm Models

Our emphasis in this White Paper will be on the Z-Metrics publicly owned firm model which is based on defaulted and non-defaulted, non-financial firms (Figure 4A lists the number of firms by year in that sample). In addition, we will construct essentially a private firm model, although the data is from publicly held companies (Figure 4B) and we replace market value with book value of equity. The application of our privately-held firm model will be useful for clients who are interested in non-public firms, although data on the private companies will have to be supplied by either the client or from databases that will be deemed relevant. We also anticipate that some clients will be interested in "private" leveraged buyout firms with publicly held debt and financial statements available.

One additional application of both the publicly held and privately held firm models utilized together is for those clients primarily interested in equity market investments. Since the public model contains equity market value variable(s), a firm's score will already be influenced by either a rising or falling stock price. For example, an alternative strategy to investing in the highest Z-Metrics score firms' equities might be to select only those firms whose fundamentals have improved, reflected by improved private firm Z-Metrics ratings, but whose public-firm model ratings have not escalated in the most recent period.

While we find that the inclusion of market value of equity variables adds considerable information and predictive power to our public firm models, we expect that the performance of our private firm model will be of particular relevance to those clients who are interested as well in only the fundamentals of credit risk of enterprises. In essence, the private firm model applied to public firms strips away the influence of the market and isolates a firm's fundamental operating and financial performance. A user will, therefore, assess both models' PDs and ratings.

In any case, we will be able to supply credit scores, PDs, and Z-Metrics Ratings based on both publicly held as well as privately held firm models for one- and five-year horizons.

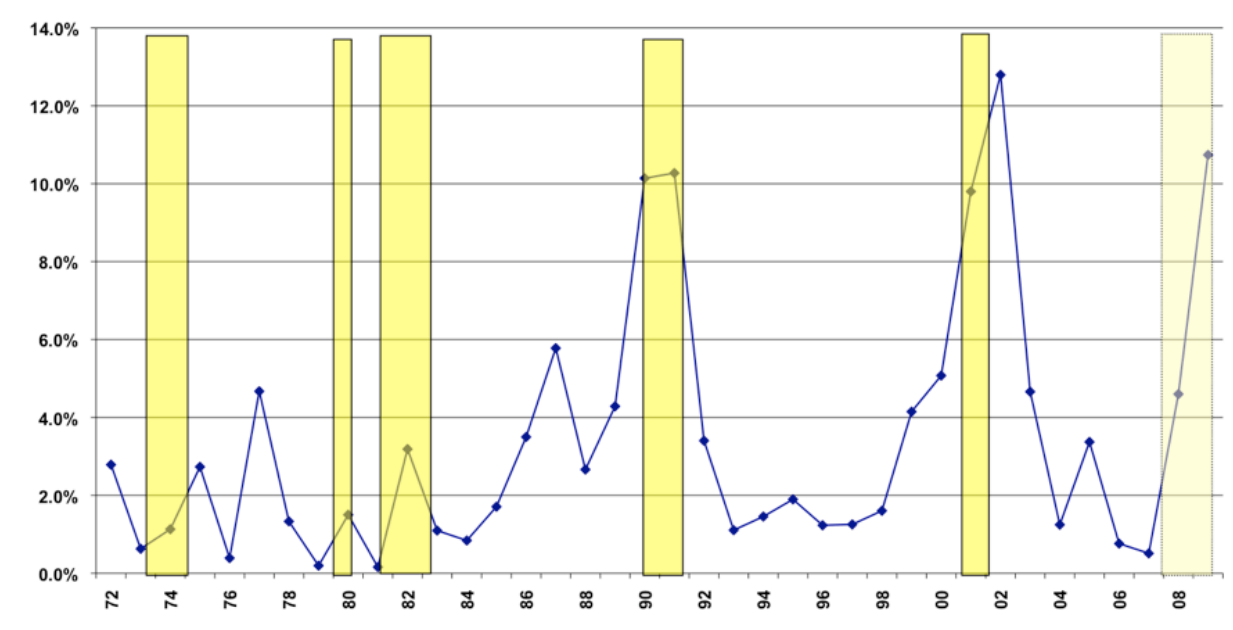
Macro-Aggregate Variables

As noted earlier, our one-year PD models, both public and private, will assess the additional value-added of variables which are not specific to individual firms, but which capture systemic or market factors, heightening or lessening stress on firm performance. As shown in Figure 7, when the economy is in a recession, the aggregate default rate on high-yield bonds increases and tends to peak near or at the end of a recession. For example, we observe double-digit high-yield bond default rates in 1990 and 1991, again in 2001 and 2002, and finally in 2009. In each cycle, the economy was in a recession.

Another aggregate measure that we find adds value to our models is the yield-spread , or risk premium, between risky debt and risk-free securities. For example, Figure 8 shows the time series regression relationship between the yield-spread on high-yield bonds and 10-year U.S. Treasury bonds. In this case, the yield-spread is observed one year prior to the default rate. Note that the regression relationship is extrememly significant for the period 1978-2008, essentially our sample period, with the yield-to-maturity spread explaining about 70% of the variation in dollar-denominated high-yield bond default rates.

FIGURE 7

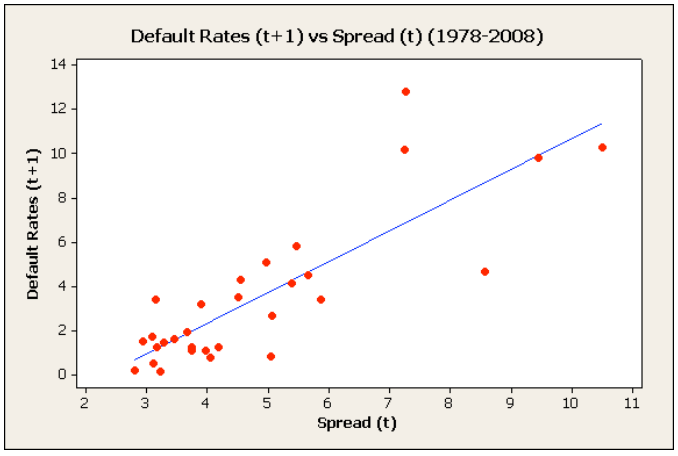
Historical Default Rates and Recession Periods in the U.S.: High Yield Bond Market 1972-2009



Periods of Recession: 11/73 - 3/75, 1/80 - 7/80, 7/81 - 11/82, 7/90 - 3/91, 4/01 - 12/01, 12/07 - present.
Sourcess: E. Altman (NYU Salomon Center) and National Bureau of Economic Research

FIGURE 8

Dollar Denominated Default Rate Predictions: Defaullt Rate [t+1] Versus Yield Spread [t]



The regression equation is

Default Rate = - 3.25 + 1.39 * Spread

Predictor	Coef	SE Coef	T	P
Constant	-3.2490	0.9072	-3.58	0.001
Spread	1.3904	0.1741	7.99	0.000

S = 1.86079 R-Sq = 69.5% R-Sq(adj) = 68.4%

Source: E. Altman and B. Karlin, "Default Rates and Returns on High-Yield Bonds", NYU Salomon Center, February 2010.

Z-Metrics Model Construction and Tests

Logit Model Estimation

- We estimate our credit scoring model based on a standard logit-regression functional form whereby:

  $CS_{i,t} = \alpha + \Sigma\beta X_{i,t} + \varepsilon_{i,t}$ (1)

  $CS_{i,t}$ = Z-Metrics credit score of company i at time t

  β = variable parameters (or weights)

  $X_{i,t}$ = set of fundamental, market based and macroeconomic variables for firm/quarter observations

  $\varepsilon_{i,t}$= error terms (assumed to be identically and independently distributed)

  $CS_{i,t}$ is transformed into a probability of default by $PD_{i,t} = \frac{1}{1+\exp(CS_{i,t})}$ (2)

- Comparisons are made with the actual issuer ratings (see for example our 1989-2008 and 2009 comparisons in Figures 16 and 17 respectively, below). In order to ensure a fair comparison, credit scores are converted to agency equivalent (AE) ratings by ranking credit scores and by matching exactly the actual Agency rating distribution with the AE rating distribution at any point in time.

- We also compare our Z-Metrics results to the well established Altman Z"-score (1995) model[4].

[4] Altman's original Z-score model (*Journal of Finance*, September 1968) is well-known by practitioners and scholars alike and is considered by many as the traditional benchmark for bankruptcy prediction. It was built, however, over 40 years ago and is primarily applicable to publicly held manufacturing firms. A more generally applicable Z"-score variation was popularized in 1995 as a means to assess the default risk of non-manufacturers, and was first applied to emerging market credits. Both models are discussed in E. Altman and E. Hotchkiss, **Corporate Financial Distress and Bankruptcy**, John Wiley & Sons, 2006 and will be compared in several tests to our new Z-Metrics model. The Altman Z-score models do not translate easily into a probability of default or rating system, as does the Z-Metrics system.

Criteria for Selection of the Z-Metrics Models

A number of important criteria were the basis for our final selection of variables in the construction of our public and private one- and five-year credit scoring models. These included:

- Accuracy ratios for credit-event prediction of both Type I (correct default prediction) and Type II (correct non-default prediction) results
- Comparison of our accuracy ratios with existing models such as rating agencies and Altman's Z-score models
- Comparison of accuracy ratios for both in-sample and out-of-sample results
- Comparison of Agency issuer ratings with our Z-Metrics AE ratings
- Discriminatory power of our model across the entire spectrum of ratings, including high rating levels for one-year and five-year horizons
- Stability of explanatory power and parameters of individual variables over time and across sectors of non-financial industrial firms
- Selection of macro-variables and fundamental factors that reflect timely changes in stress for industrial firm credit-worthiness over time, i.e., robustness to bear and bull markets
- Examination of key variables to stress the credit score, PD and rating results

Accuracy Ratios

One of the key success determinants of any credit risk model is how well the model classifies firms into high risk (low ratings) levels based on data from before some critical credit event takes place. In our model's estimation, the objective is to attain high levels of accuracy (low levels of errors) to classify, and ultimately to predict, firms which default on their obligations and/or go bankrupt. The standard measure for these assessments is the so-called "accuracy ratio," which measures the proportion of credit-event firms correctly predicted to go bankrupt or non-bankrupt based on different credit score cut-off levels. In

essence, the objective is to maximize the Type I and Type II accuracy levels (minimize errors) for test and holdout samples of firms.

Figure 9 compares the Type I accuracy ratios for our Z-Metrics AE ratings to actual Agency ratings and Altman Z"-score AE ratings, for the entire sample period 1989-2008, for our 1 year and 5 year models. The results in Figure 9 are based on the percentage *Type I* accuracy (predicting default when the firm defaults) using the credit score cut-offs for different AE rating classes. The various AE rating classes can also be thought of as different PD or credit score levels. Rating class 1 includes firms with a rating ≤ CCC+/Caa1, rating class 2 = B-/B3, 3 = B, 4 = B+/B1 and so on. Figure 10B shows the *Type II* error rates for Z-Metrics AE ratings, actual Agency ratings, and AE ratings for Z"-scores.

From Figures 9 and 10A, we see that if the cut-off score was set at the 4th rating class equivalent level (B+), our (12-month) Z-Metrics model would result in about a 10% error (90% accuracy) rate for one-year predictions, compared to an 18% error rate for Agency ratings and about a 20% error for the Z"-score model. For a five-year horizon, Type I error rates are about the same for Z-Metrics models and Agency ratings. This latter result is not surprising since the Rating Agencies' through-the-cycle methodology is a longer term perspective approach as is our five-year Z-Metrics approach.

Figure 10B also shows the Type II error rate (false positive prediction of default) for the three models based on a one-year prediction horizon at various rating class cut-off levels. As expected, there is very little difference between the three models at all rating class cut-off levels since the ratio of non-defaults to defaults is greater than fifteen to one over the entire 20-year sample period. At the 4th rating class cut-off level, the Type II error rate is approximately 20% for all models. So, to conclude, the Type I and II error rates at our proposed cut-off score level (B+) results in a 10% Type I and 20% Type II error rate. These compare very favorably to Agency ratings and Z"-score models.

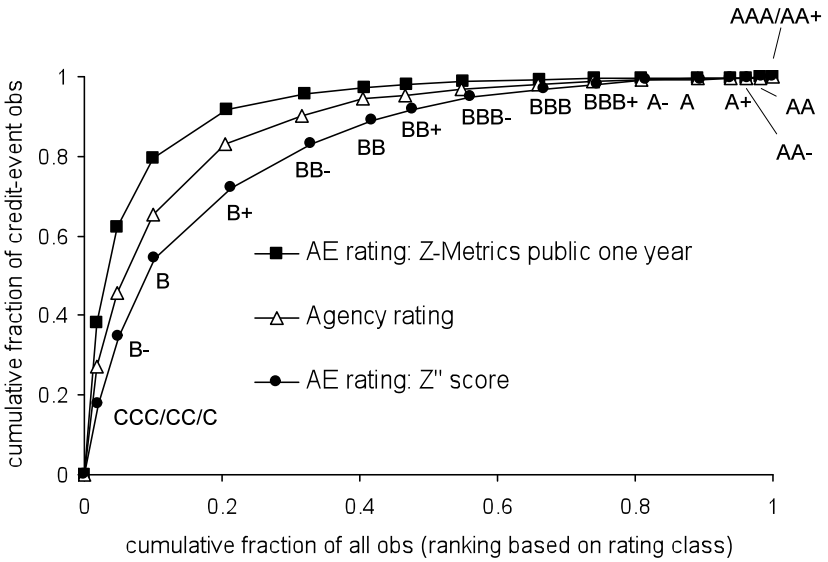
Figures 11A and 11B compare the Z-Metrics AE ratings with the Agency ratings over one-year and five-year horizons for two different 10-year sample periods: an in-sample 1989-1998 period (equivalent to a model construction sample) and 1999-2008 (equivalent to a holdout or out-of sample period). Note that the Z-Metrics public model is approximately 7.5% more accurate for one-year predictions in the in-sample period and a little better, about 10.0% more accurate, in the out-of-sample period. The Z-Metrics one-year public model has better accuracies for all horizon periods during the in-sample period (Figure 11A). In the out-of-sample period test (Figure 11B), the Z-Metrics one-year public model outperforms the Agency ratings for all horizon periods as well. Similar results are observed with the five-year Z-Metrics model compared to Agency ratings. The Z-Metrics private-firm models' results are not as impressive but still quite acceptable. This is mainly due to the lack of market value of equity data in the private model. Of course, most of the private firms will not, in reality, have an Agency rating.

Stability of the Models

We assessed the stability of the Z-Metrics models by observing the accuracy ratios for our tests in the in-sample and out-of-sample periods (Figures 11A and 11B) and also by observing the size, signs and significance of the coefficients for individual variables. The accuracy ratios were very similar between the two sample periods and the coefficients and significance tests were extremely close.

FIGURE 9

Cumulative accuracy profile curves for Agency ratings[1], Z"-score, and Z-Metrics agency equivalent (AE) ratings (1989 - 2008)



1 Agency ratings refer in the first place to corporate issuer S&P ratings. Corporate issuer Moody's ratings are added if a corporate issuer S&P rating is not available.

Sources: Altman NYU Salomon Center Default and Bankruptcy databases; COMPUSTAT.

FIGURE 10A

Type I error rates for Agency ratings, Z"-score, and Z-Metrics agency equivalent (AE) ratings (1989 - 2008): one year prediction horizon for publicly owned firms

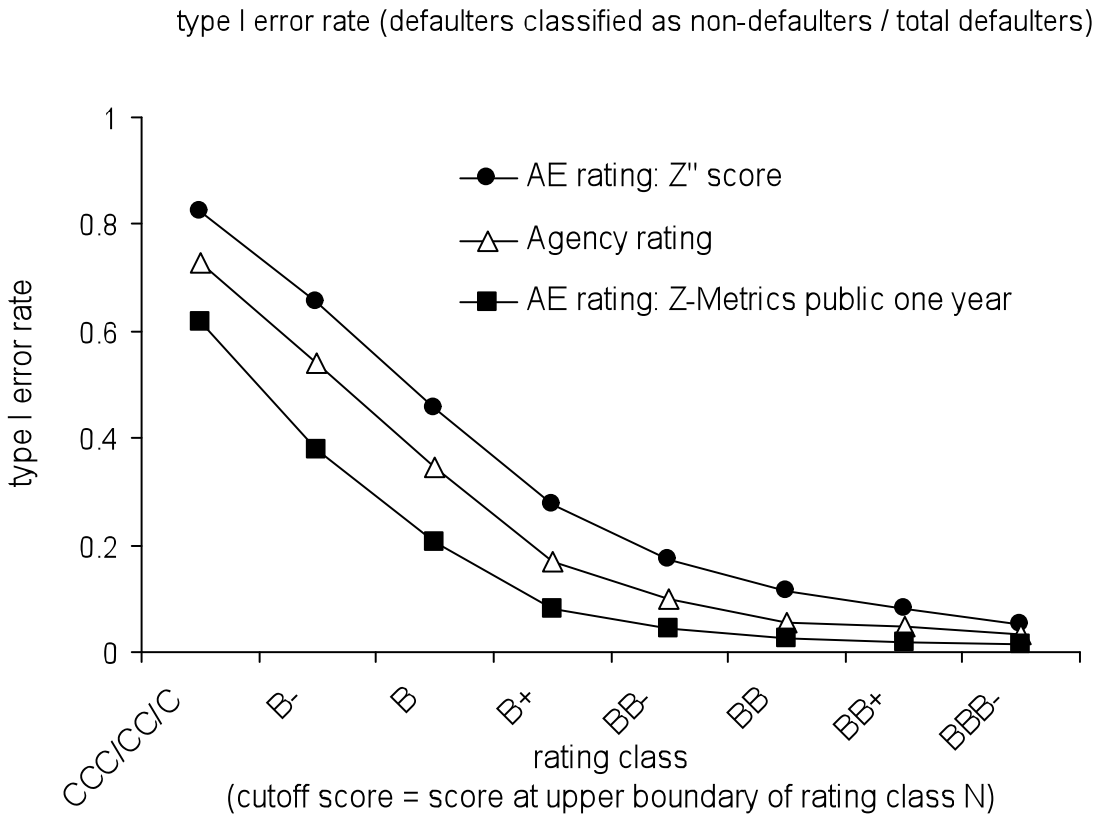


FIGURE 10B

Type II error rates for Agency ratings, Z"-score, and Z-Metrics agency equivalent (AE) ratings (1989 - 2008): one year prediction horizon for publicly owned firms

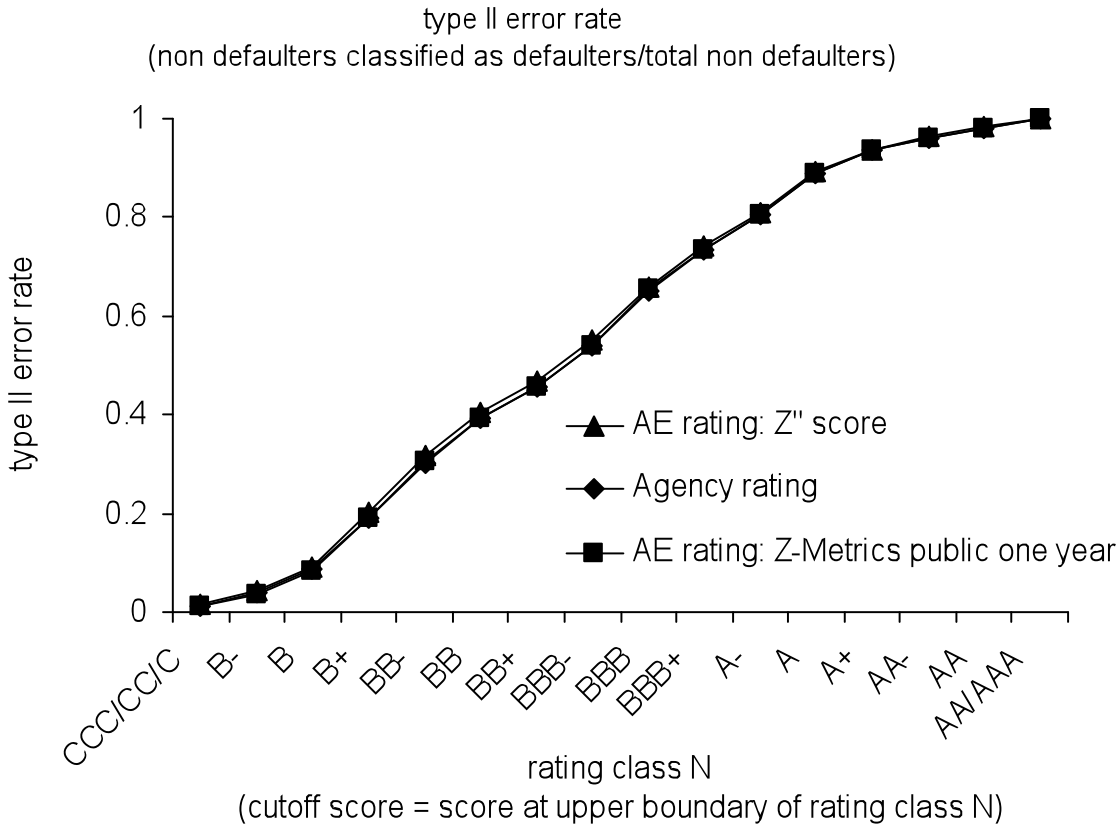


FIGURE 11A

In sample test: Relative ACR ratio values for Z-Metrics agency equivalent (AE) ratings compared to Agency ratings. Models are estimated and tested in the 1989 - 2008 sample for public and private firm models

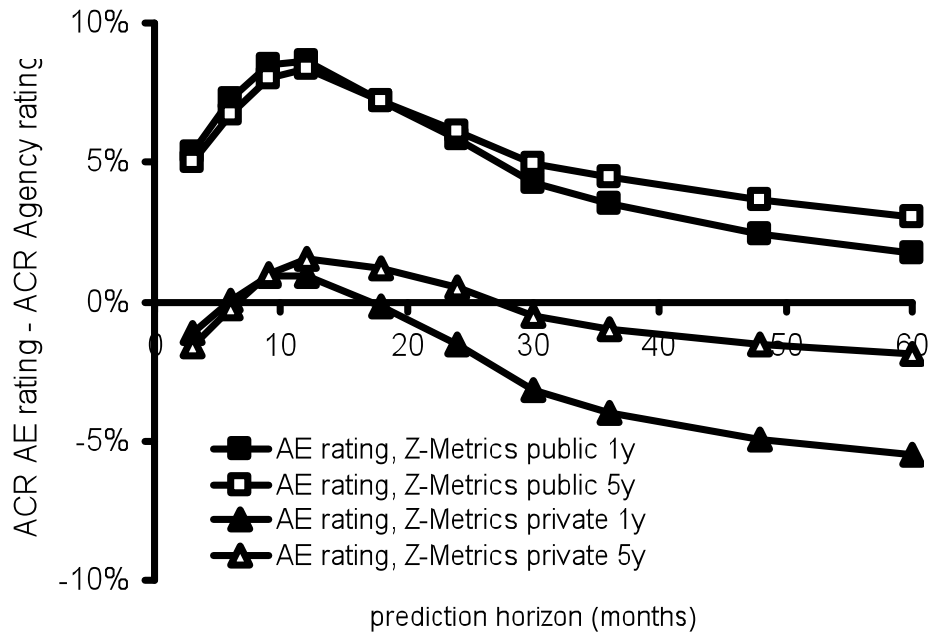
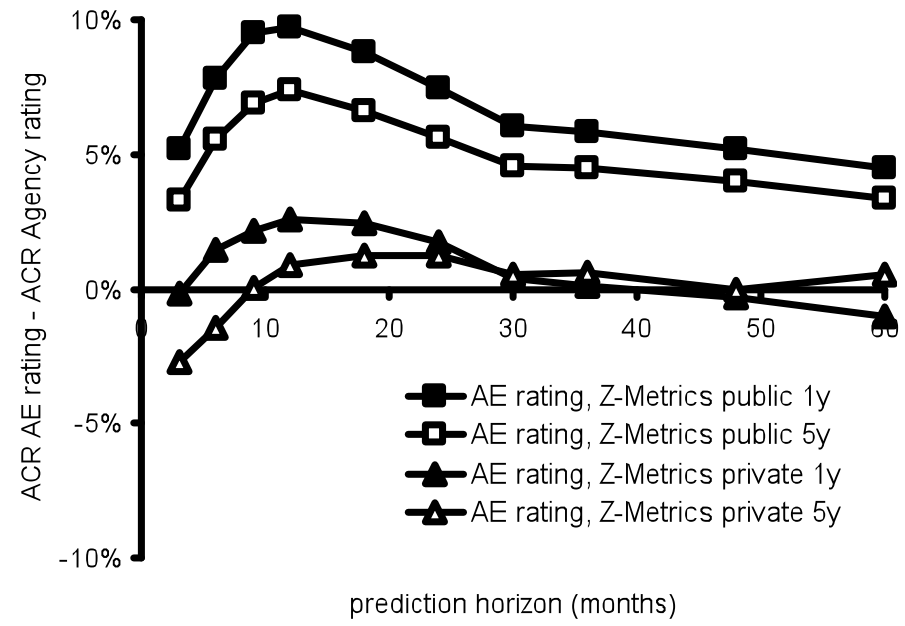


FIGURE 11B

Out of sample test: Relative ACR ratio values for Z-Metrics agency equivalent (AE) ratings compared to Agency ratings. Models are estimated in a 1989 - 1998 sample and tested in the 1999 - 2008 sample



The Z-Metrics™ Rating System

The Z-Metrics Rating System has 15 rating categories ranging from the most credit worthy "ZA+" rating to the lowest quality "ZF-" rating. The rating categories are based on a firm's probability of default (PD) for one- and five-year horizons for public firms, as shown in Figure 12A, and private firms, as shown in Figure 12B. The PD of an entity is computed via the logit transformation of a raw score, as shown in equation (2).

For public firms (Figure 12A), note that ratings ZA+ to ZB- (top 6 levels) all have one-year PDs of less than 0.2% and less than 4.5% for five years. We classify these firms as **"high-grade."** The **"low-grade"** levels are for one-year PDs greater than 1% and greater than 14% for five-year PDs. The **"mid-grade"** range are the ZC levels. We observe that within the period 1989-2008, 22.6% of the firms had one-year PDs greater than 1% and about the same percentage (22.2%) had five-year PDs above 14%. A 16.9% percentage of the observations had extremely low one-year PDs of less than 6 basis points (0.06%) – our three-top ZA categories - and 18.0% had five-year PDs less than 1.75%. About 5.3% of the observations had one-year PDs of more than 10% (our bottom-three ZF ratings), and 5.4% had five-year PDs of at least 45%; 1% of the firms had five-year PDs greater than 80%.

In addition to the rating distribution over relatively long sample periods (e.g., 20 years), our model can, and will, calculate one-year PDs as of a particular point in time. For example, as of year-end 2008 (Figure 13), when several macro-variables and particularly our stock market measures indicated a stressed environment based on such measures as yield spreads, unemployment rates, and equity/debt ratios, the distribution of PDs shows a much smaller percentage of firms with extremely low one-year PDs (e.g., only about 8.4% of firms had PDs below 0.06% [ZA], compared to 16.9% for the entire 20-year sample period) and a higher percentage of firms with high one-year PDs (e.g., about 9.8% of firms had PDs above 10% [ZFs] and about 33.4% of firms had PDs above 1.0% [ZD + ZF], compared to respectively

5.3% and 22.6% for the entire 20-year sample period). Our five-year horizon model does not have macro-variables since we assume that such factors are not likely to affect default probabilities as far out as 3-5 years.

A one-year PD of 20 basis points (0.20%) in the Z-Metrics Rating System is equivalent to a BBB (Baa) rating and a one-year PD of about 4.0% (400 bps) is analogous to single B companies.[5] For five years, a BBB (Baa) equivalent company is comparable to a Z-Metrics PD of about 2.5%-3.5% and a B rated company would have an equivalent Z-Metrics PD of 20-30%.

Based on our Z-Metrics results, our rating system classifies firms in the high-grade range of credit risk [ZA and ZB ratings], mid-grade range [ZC ratings] or low-grade range [ZD and ZF ratings].

Figure 13 (top panel) shows the proportions of high-grade companies each year over the period 1989-2008; proportions of mid-grade credit risk companies are shown in the central panel and low-grade companies are in the bottom panel. Note that the proportions of high risk (low-grade range of ratings) increases during the stress periods of 1990-1991, 2000-2002 and again in 2008. Indeed, during these stress periods, we can observe that the proportions of high, medium and low-grade ranges of ratings were approximately equal at about one-third each.

Small-Firm Models

Preliminary results on building and testing models for relatively small firms (<$100 million in sales) indicate quite comparable absolute accuracy performance results and clearly imply that there is some meaningful value added to utilizing a specific model for small firms. This preliminary conclusion seems to hold for both publicly and privately-held enterprises.

[5] Cumulative default frequencies are published regularly by the three major rating agencies and are combined and compared in Caouette, Altman, et al, **Managing Credit Risk**, 2nd edition, John Wiley & Sons, (2008), p.263.

FIGURE 12A

Definition of Z-Metrics Ratings for *public* models

Z-Metrics™ Ratings	Z-Metrics public - 1 Year					Z-Metrics public - 5 Years			
	one year PD		% representation			five year PD		% representation	
	min	max	1989/ 2008	2008		min	max	1989/ 2008	2008
ZA+	0.00%	0.02%	3.5%	2.1%		0.00%	0.75%	3.4%	2.4%
ZA	0.02%	0.04%	5.8%	4.6%		0.75%	1.25%	7.0%	5.4%
ZA-	0.04%	0.06%	7.6%	6.1%		1.25%	1.75%	7.6%	6.4%
ZB+	0.06%	0.09%	10.6%	10.0%		1.75%	2.50%	10.6%	9.9%
ZB	0.09%	0.14%	10.9%	11.2%		2.50%	3.50%	11.1%	11.3%
ZB-	0.14%	0.20%	8.8%	9.1%		3.50%	4.50%	8.1%	8.6%
ZC+	0.20%	0.30%	9.4%	10.8%		4.50%	6.00%	8.6%	9.7%
ZC	0.30%	0.50%	10.1%	10.4%		6.00%	9.00%	11.1%	12.1%
ZC-	0.50%	1.00%	10.6%	11.4%		9.00%	14.00%	10.0%	10.3%
ZD+	1%	2%	7.6%	8.2%		14%	20%	6.3%	6.8%
ZD	2%	4%	5.2%	5.8%		20%	30%	6.0%	6.6%
ZD-	4%	10%	4.5%	4.7%		30%	45%	4.5%	4.9%
ZF+	10%	25%	2.6%	2.6%		45%	65%	3.0%	3.2%
ZF	25%	50%	1.5%	1.6%		65%	80%	1.4%	1.6%
ZF-	50%	100%	1.2%	1.3%		80%	100%	1.0%	1.0%

The boundaries of each rating class are fixed and based on probabilities of default.

FIGURE 12B

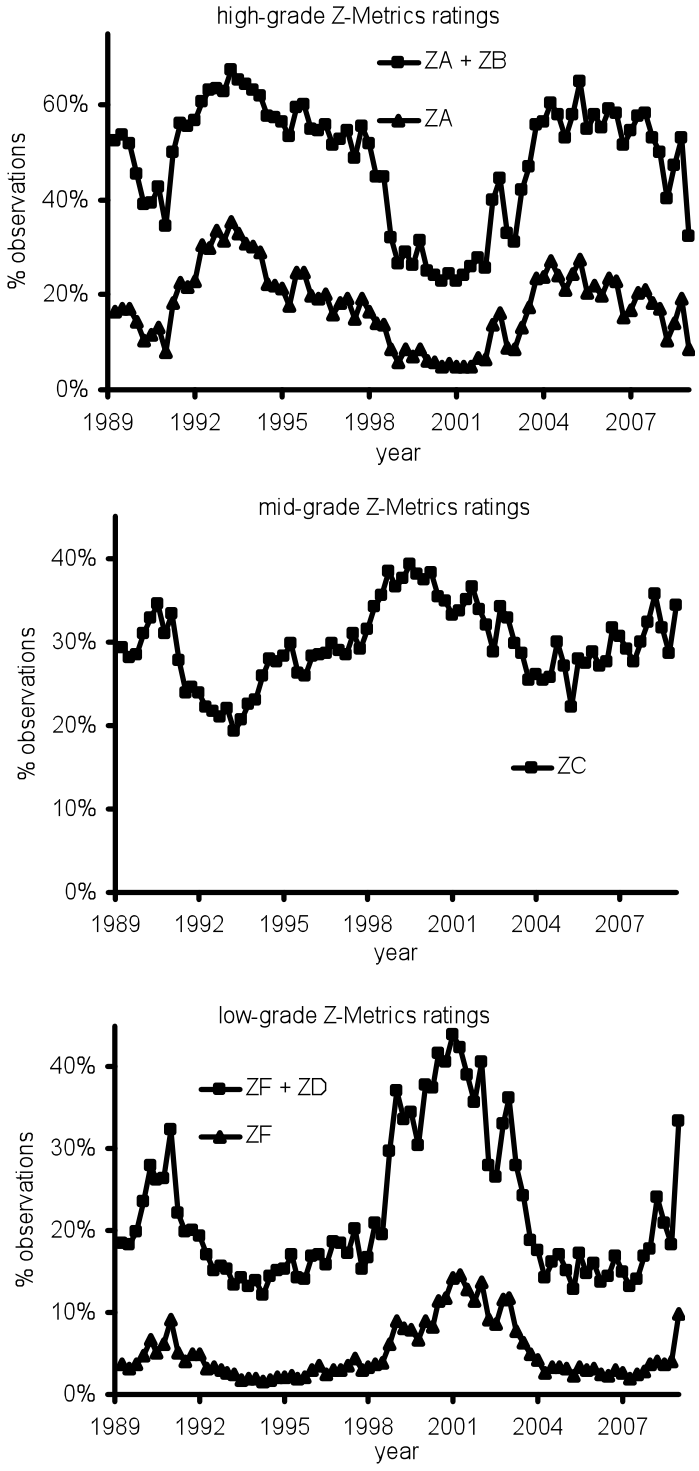
Definition of Z-Metrics Ratings for *private* models

Z-Metrics™ Ratings	Z-Metrics private - 1 Year					Z-Metrics private - 5 Years			
	one year PD		% representation			five year PD		% representation	
	min	max	1989/ 2008	2008		min	max	1989/ 2008	2008
ZA+	0.00%	0.03%	2.7%	0.0%		0.00%	1.00%	1.7%	2.5%
ZA	0.03%	0.05%	4.8%	2.4%		1.00%	1.50%	6.2%	7.9%
ZA-	0.05%	0.08%	7.7%	5.8%		1.50%	2.00%	6.5%	8.3%
ZB+	0.08%	0.13%	10.6%	8.9%		2.00%	3.00%	12.4%	14.3%
ZB	0.13%	0.20%	10.7%	10.7%		3.00%	4.00%	11.1%	11.4%
ZB-	0.20%	0.30%	10.5%	11.2%		4.00%	5.00%	9.0%	9.0%
ZC+	0.30%	0.45%	9.6%	11.3%		5.00%	6.50%	9.7%	9.3%
ZC	0.45%	0.70%	9.1%	10.5%		6.50%	9.00%	10.3%	9.8%
ZC-	0.70%	1.50%	11.9%	14.3%		9.00%	13.00%	8.9%	8.1%
ZD+	1.5%	3.0%	7.9%	9.8%		13%	20%	8.2%	7.4%
ZD	3.0%	5.0%	4.6%	5.2%		20%	30%	6.5%	5.3%
ZD-	5.0%	10.0%	4.7%	4.8%		30%	45%	5.4%	4.1%
ZF+	10.0%	18.0%	2.8%	2.7%		45%	55%	1.9%	1.2%
ZF	18.0%	30.0%	1.4%	1.4%		55%	65%	1.2%	0.8%
ZF-	30.0%	100.0%	0.8%	1.0%		65%	100%	1.1%	0.7%

The boundaries of each rating class are fixed and based on probabilities of default.

FIGURE 13

Rating Scale distribution for Z-Metrics Ratings for Public firms' model results (1989 - 2008)



Stress Ratings

Any risk manager will tell you that a single estimate of default risk, while helpful and representing a base-case scenario for future health/distress conditions, should be supplemented by worse case or stressed conditions. Indeed, one of the criticisms of established credit agency ratings is that the public is offered a single rating for each entity or security (although the agencies do publish whether the entity is on a type of "watch-list" or "outlook" for positive or negative movement in the near future). Certainly, one of the major faults of ratings during the recent residential mortgage-backed security (RMBS) debacle is that the ratings assigned to these complex securities did not address the possibility of a significant drop in housing prices. As such, the observed ratings proved to be wildly optimistic. Although not nearly as flagrant as RMBS problems, ratings on individual companies and their securities can be criticized as well since they present a base-estimate, but not a truly stressed environment rating.[6]

To address these issues, we propose to assign Z-Metrics Stressed Ratings based on potential changes in several key variables in our models. These variables include equity price and earnings. Wherever these variables are used in ratios, the stress will be applied to all of these ratios. Specifically, we propose to stress these variables as follows:

- Equity price -25.0%
- Earnings -5.0% (as a percentage of total assets)

Figure 14 details the change in the proportion of firms assigned to our Z-Metrics Rating System based on stressed values for each of these indicators while figure 15 illustrates these results graphically. Note that as expected, all rating changes are in the negative direction as the firms become more risky under the various stressed scenarios. Also, as expected the

[6] This issue is discussed in Altman, et.al., (*Regulation of Rating Agencies*), e-book from the NYU Stern School of Business, 2009, Chapter 15 of *Real Time Solutions for Financial Reform*.

greatest average downward rating change is when both indicators are stressed. The greatest rating changes from the original distribution (column 1, from Figure 14A) are found in the high-grade range, in the ZA and ZB categories.

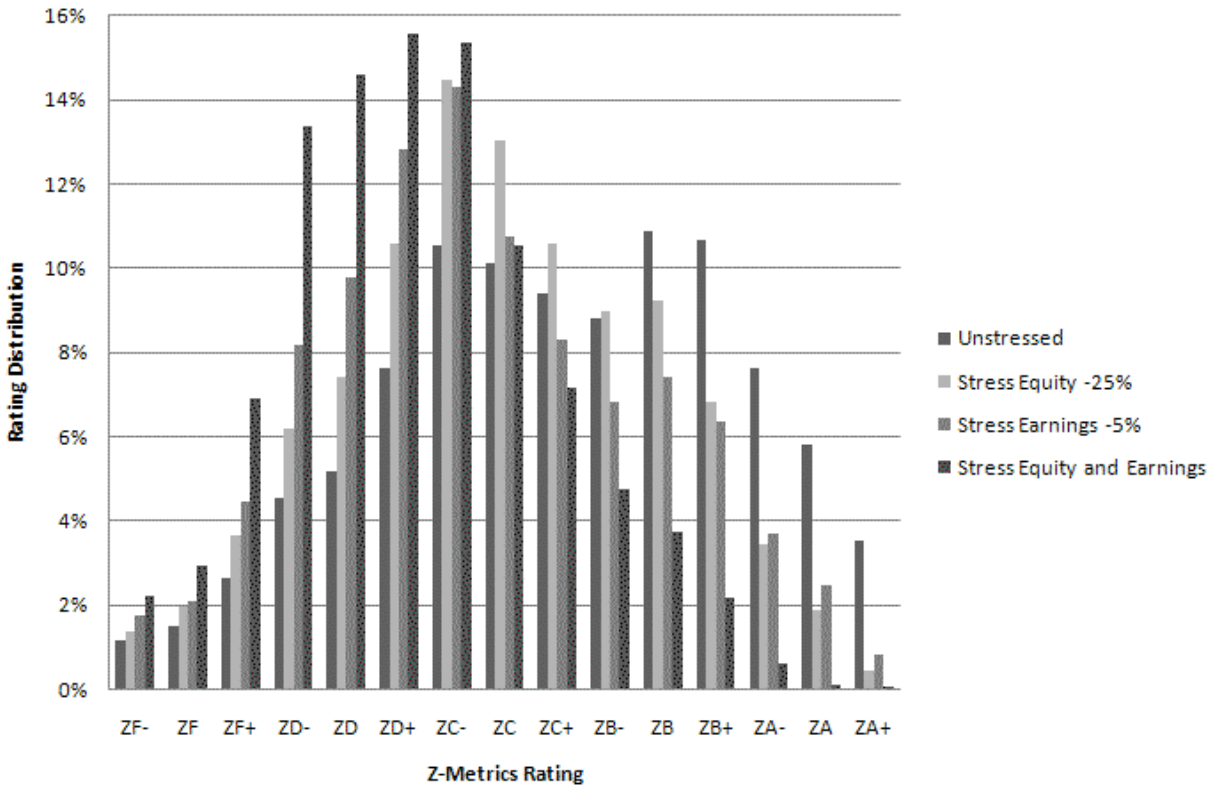
Of the two critical variable indicators, our stressed scenarios are slightly more severe with a drop in earnings of 5% of total assets, compared to a 25% drop in market value of equity. For example, the average ZB firm falls by an average of 2.2 notches to about ZC+ when the earnings variable is stressed while the average ZB firm falls by 1.7 notches when the equity variable is stressed. Firms already in the lower rating categories (ZFs), show smaller rating changes although their PDs could increase a fair amount (for the lowest ZF- rating category rating changes are obviously absent). Finally, whether or not the various stress scenarios are relevant is based on the assessment of the analyst/investor. We will present these stress scenario ratings for each firm, in any case. In most situations, the most likely variable to become stressed is the market value of equity ratio, especially if there is a systemic change in the stock market.

FIGURE 14

Stress Scenario Impact on Z-Metrics Ratings via Changes to Equity Price and Earnings

	ZF-	ZF	ZF+	ZD-	ZD	ZD+	ZC-	ZC	ZC+	ZB-	ZB	ZB+	ZA-	ZA	ZA+
Unstressed Distribution:	1.16%	1.49%	2.65%	4.52%	5.18%	7.64%	10.56%	10.11%	9.39%	8.82%	10.89%	10.65%	7.62%	5.81%	3.51%
Stress Equity Price -25%, Earnings 0%															
Avg Chg in Rtg:	0	-0.15	-0.25	-0.37	-0.53	-0.67	-0.74	-0.94	-1.37	-1.52	-1.72	-1.68	-1.65	-1.62	-1.30
New distribution %:	1.39%	1.94%	3.67%	6.18%	7.40%	10.57%	14.49%	13.01%	10.59%	8.98%	9.23%	6.82%	3.43%	1.86%	0.45%
Stress Equity Price 0%, Earnings -5%															
Avg Chg in Rtg:	0	-0.38	-0.42	-0.56	-0.82	-1.11	-1.27	-1.50	-1.80	-2.09	-2.20	-1.95	-1.68	-1.51	-0.96
New distribution %:	1.77%	2.08%	4.44%	8.19%	9.80%	12.82%	14.31%	10.74%	8.28%	6.81%	7.41%	6.35%	3.69%	2.48%	0.83%
Stress Equity -25%, Earnings -5%															
Avg Chg in Rtg:	0	-0.59	-0.74	-0.96	-1.33	-1.75	-2.11	-2.49	-2.92	-3.43	-3.80	-4.00	-4.05	-3.86	-3.26
New distribution %:	2.21%	2.92%	6.92%	13.37%	14.61%	15.56%	15.36%	10.53%	7.17%	4.75%	3.72%	2.15%	0.60%	0.11%	0.01%

FIGURE 15
Effect of Stress on Rating Distribution



Prediction Results – 2009 Defaults/Bankruptcies

Perhaps the most important robustness tests of credit scoring models are how well they *predict* critical events based on samples of firms which were not used to build the model, and particularly if the events took place subsequent to the building of the model(s). An associated test is how well the model does compared to other methods which are available and where the data and comparable results are transparent, again outside the test sample period. Figures 16 and 17 show our Z-Metrics models' results for defaults/bankruptcies that occurred in 2009. These results are indicative of the models' predictive accuracy for both our public (16A) and private (16B) Z-Metrics models for one-year and five-year horizons and also comparative tests with Agency ratings and the Z-score and Z"-score models. Z-Metrics model results are displayed in terms of AE ratings, probabilities of default and also our own rating system.

Comparative Results

Figures 16A (public firm model) and 16B (private firm model) list a sample of 2009 defaults and compare - one-year prior to default - our Z-Metrics AE ratings with Agency ratings[7] and AE ratings for the Z and Z"-score models. Results are presented for both our public and private firm Z-Metrics models, the latter being relevant when, for some reason, we are not able to find a market value of equity available (like for a LBO). We also show our results for a smaller sample of bankruptcies where data was available but the firm did not have publicly rated bonds outstanding. In addition, we show Z-Metrics PDs for our one-year and five-year models, as well as the associated Z-Metrics Ratings (see Figures 13A and 13B). Finally, in Figure 17, we summarize the comparisons between Agency ratings with our Z-Metrics AE ratings for the entire test sample period (1989-2008), as well as for the out-of-test-sample period, 2009.

Equivalent Ratings Test Results

Figure 16A compares Agency ratings with Z-Metrics AE ratings for 38 non-financial defaulting companies rated by S&P[8]. The Z-Metrics AE ratings are based on the percentage of firms rated by S&P in each rating class and then using those same percentages within the entire distribution of Z-Metrics credit scores. So, if there are 2% of all firms with a CCC+ rating and below, or actual rating = 1, we classified a firm within the lowest 2% of all Z-Metrics scores also to the lowest Z-Metrics AE rating class (AE = 1). This matching of rating distributions is done each point in time. Therefore, a direct comparison is possible. We also list the Z-Metrics PDs for one- and five-year horizons as well as our own Z-Metrics Ratings for

[7] Whenever possible, we use the S&P actual rating. When the S&P rating was not available, and Moody's was, we used Moody's. Results are essentially the same if we reversed the process and used Moody's as our primary reference rating.

[8] Actual ratings range from 1 for CC/CCC categories, 2 for B-, 3 for B, …, to 16 for AAA/AA+ rated companies.

56 non-financial defaulting companies (for 18 firms we did not have an Agency rating). Similar comparisons are made using the Z-score models.

Examples of our comparative analysis show that *Accuride* was rated B+ (2) by S&P 11 months prior to its default on November 2009 and its Z-Metrics AE rating was B- (4), with a PD of 29.8% for one year and 66.8% for five years. Its Z-Metrics Rating was the second lowest, ZF. *Accuride's* Z"-score had an AE rating of BB-(5). *General Motors* has a actual Agency rating of B- ten months prior to its default/bankruptcy in June 2009, but had a CCC (15) rating from Z-Metrics, one-year PD of 31.6%, a 5-year PD of 67.3%, and a Z-Metrics Rating of ZF for both horizons. The Z"-score also had a CCC (15) rating. Another example, *Spectrum Brands* actual Agency rating was CCC (15) while the Z-Metrics AE rating was B- (4) 12 months prior to default. For Spectrum, the Z"-score had an AE rating of B+ (2). In the first two examples, the Z-Metrics model gave a better default prediction while in the third example, the Agency rating performed better.

Figure 17 summarizes the in-sample (1989-2008) comparisons between the S&P rating and the Z-Metrics' AE ratings and also the out-of-sample (2009) results. We believe these comparisons, along with the earlier discussed accuracy ratios, clearly show Z-Metrics' overall superiority to both actual Agency ratings and the Z"-score models' AE ratings.

For the period 1989-2008, based on 402 defaulted firm comparisons, we observe that the one-year Z-Metrics public firm model had a lower (higher PD) rating equivalent in 206 instances, a higher (lower PD) result in 96 instances and the same rating in 100 instances, compared to the Agency rating at approximately one year prior to default. For the one-year Z-Metrics private firm model the plus and minus differences are about equal (213 vs. 181, with 141 the same as Agency ratings). Results for our five-year models were essentially the same. For the out-of-sample 2009 defaults, the comparative results were 16 firms with Z-Metrics lower AE ratings (higher PDs), 6 with higher AE ratings (lower PDs) ratings and 10 with the same rating. So, in both sample periods, the rating agencies had a higher rating (lower

implied PD) than did Z-Metrics in more that 2 out of every 3 defaulting cases where the two ratings differed.

It is also worth noting that the average Agency rating for firms one year before default was 0.62 rating classes higher than the Z-Metrics AE rating for the in-sample 20-year period and 0.50 rating classes higher for the out-of-sample 2009 period (Figure 17).[9] This is a statistically significant improvement over the rating agencies since the p-value was less than 0.0001 in these comparisons

Results comparing our new Z-Metrics model to Altman's original Z and Z"- score models are even more striking. The Z-score models had significantly higher (1.5 rating notches) rating equivalents (lower PDs) for firms one year before default in our samples. For the period 1989-2008, the Z-score model had higher AEs in 57% of the cases, lower AEs in 21% of cases, and the same AEs in 22% of cases. For Z"-scores, the results are almost identical. In 2009, the results were even more impressive, with higher AEs in 75% of the cases, lower AEs in 18% of cases, and the same AEs in 7% of cases. We conclude that for both the in-sample and out-of-sample results, defaulted firms were overall deemed more risky one year prior to default using our Z-Metrics approach than either actual Agency ratings or AE ratings for Z-score models.

The standard error of notch differentials across all firms (defaulted and non-defaulted) is approximately 2.8 notches for the Z-Metrics one-year public model and 2.3 notches for the five-year public model. Based on the average differential of defaulting firms and the standard error differences across all firms, we find that the Z-Metrics rating system provides superior and considerably different results than either the rating agencies or Z-score models.

[9] The maximum differentials between Agency ratings and the Z-Metrics AE ratings was eight (8) rating notch classes higher and seven (7) rating notch classes lower for the 20-year sample period. For 2009 defaults, Agency ratings had a maximum differential of three rating notch classes above or below AE ratings.

FIGURE 16A

Out of sample comparison of default prediction results for 2009 defaults: Agency Ratings, *Public* Z-Metrics™ and Z-score Agency Equivalent (AE) Ratings, Public Z-Metrics™ Ratings and Probabilities of Default data are from one year prior to default.

Company	Month of default in 2009	Ratings &PD Data (months before default)	total liabilities ($ mio)	Agency rating	Agency Equivalent (AE) Ratings				Z-Metrics PD values		Z-Metrics Ratings	
					Z-Metrics models		Z-score models					
					1y public macro	5y public	Z score	Z" score	1y public macro	5y public	1y public macro	5y public
ACCURIDE CORP	10	11	840	4	2	2	5	5	29.8%	66.8%	ZF	ZF
ALLIS-CHALMERS ENERGY INC	6	13	639	3	6	5	5	6	0.3%	7.5%	ZC+	ZC
AMERICAN ACHIEVEMENT CORP	2	13	336	3	.	.	.	.	.	.	.	.
AVENTINE RENEWABLE ENERGY	4	11	408	4	3	3	9	8	3.7%	29.0%	ZD	ZD
BEAZER HOMES USA INC	9	13	2606	3	3	3	.	.	4.0%	25.3%	ZD-	ZD
BUILDING MATERIALS HLDG CP	6	13	613	2	2	2	9	5	13.1%	34.3%	ZF+	ZD-
CARAUSTAR INDUSTRIES INC	5	12	432	2	1	1	5	3	14.5%	53.3%	ZF+	ZF+
CHAMPION ENTERPRISES INC	11	13	702	3	3	3	5	4	5.2%	37.4%	ZD-	ZD-
CHEMTURA CORPORATION	3	13	2563	7	5	5	4	4	0.7%	8.2%	ZC-	ZC
COMMERCIAL VEHICLE GROUP INC	8	13	334	4	5	5	6	6	0.3%	7.6%	ZC+	ZC
DAYTON SUPERIOR CORP	4	11	407	3	1	1	3	2	23.1%	66.2%	ZF+	ZF
EDDIE BAUER HOLDINGS INC	6	13	555	2	2	2	3	2	4.8%	36.7%	ZD-	ZD-
ENERGY FUTURE HOLDINGS CORP	11	12	57099	2	.	.	.	.	.	.	.	.
ENERGY PARTNERS LTD	4	11	713	3	4	3	3	2	1.3%	18.4%	ZD+	ZD+
FAIRPOINT COMMUNICATIONS INC	10	11	735	6	4	5	2	3	1.4%	10.6%	ZD+	ZC-
FINLAY ENTERPRISES INC	8	12	624	1	1	1	5	5	42.6%	70.8%	ZF	ZF
FINLAY FINE JEWELRY CORP	6	12	631	1	.	.	.	.	.	.	.	.
FLEETWOOD ENTERPRISES INC	3	12	619	1	2	2	6	2	9.4%	49.8%	ZD-	ZF+
FORD MOTOR CO	4	12	272215	3	2	3	2	2	5.5%	30.6%	ZD-	ZD-
FREESCALE SEMICONDUCTOR INC	3	12	11927	4	.	.	.	.	.	.	.	.
GENERAL MOTORS CORP	6	10	184363	2	1	1	1	1	31.6%	67.3%	ZF	ZF
GEORGIA GULF CORP	7	11	2005	1	2	2	5	4	17.9%	47.2%	ZF+	ZF+
HEXION SPECIALTY CHEMICALS	3	12	5380	3	.	.	.	.	.	.	.	.
HOVNANIAN ENTRPRS INC -CL A	7	13	3155	2	1	1	.	.	19.9%	57.2%	ZF+	ZF+
IDEARC INC	3	13	10267	6	3	4	9	7	4.8%	12.4%	ZD-	ZC-
LEAR CORP	6	11	6683	4	3	3	7	4	2.9%	26.2%	ZD	ZD
LIBBEY INC	11	12	806	3	3	3	4	4	14.2%	55.1%	ZF+	ZF+
MILACRON INC	3	13	652	1	1	1	3	2	55.7%	84.0%	ZF-	ZF-

Agency ratings (S&P or Moody's) and agency equivalent (AE) ratings: CCC/CC/C = 1, B- = 2, B = 3, B+ = 4, BB- = 5, BB = 6, BB+ = 7, BBB = 8, BBB= 9

. = not available, mostly because of missing data

FIGURE 16A CONT'D

Company	Month of default in 2009	Ratings &PD Data (months before default)	total liabilities ($ mio)	Agency rating	Agency Equivalent (AE) Ratings				Z-Metrics PD values		Z-Metrics Ratings	
					Z-Metrics models		Z-score models					
					1y public macro	5y public	Z score	Z" score	1y public macro	5y public	1y public macro	5y public
R H DONNELLEY CORP	5	12	14266	4	.	.	2	3	.	.	.	.
SMURFIT-STONE CONTAINER CO	1	12	5532	4	4	3	4	3	1.3%	18.1%	ZD+	ZD+
SOURCE INTERLINK COS INC	4	12	1996	3	1	2	4	3	16.0%	50.3%	ZF+	ZF+
SPANSION INC	1	12	2183	3	2	2	3	3	8.0%	37.7%	ZD-	ZD-
SPECTRUM BRANDS INC	2	12	3315	1	2	2	3	4	14.1%	47.1%	ZF+	ZF+
TLC VISION CORP	12	13	160	3	3	3	1	1	8.7%	48.1%	ZD-	ZF+
TRONOX INC	1	11	1294	4	2	2	4	4	15.4%	40.6%	ZF+	ZD-
UNISYS CORP	7	12	3771	4	3	3	3	2	1.7%	23.9%	ZD+	ZD
VISTEON CORP	5	13	7002	3	2	2	4	3	8.1%	41.4%	ZD-	ZD-
YOUNG BROADCASTING -CL A	2	11	951	1	1	1	2	4	67.7%	83.3%	ZF-	ZF-
defaulted firms with no actual S&P(Moody's) rating available in database - 12 months prior to default												
AURORA OIL & GAS CORP	7	11	122	.	.	.	.	.	16.1%	55.0%	ZF+	ZF+
BARZEL INDUSTRIES INC	9	11	557	.	.	.	.	.	17.4%	61.5%	ZF+	ZF+
BEARINGPOINT INC	2	12	2451	.	.	.	.	.	27.7%	67.6%	ZF	ZF
CALIFORNIA COASTAL CMNTYS	10	11	266	.	.	.	.	.	46.5%	78.2%	ZF	ZF
DECODE GENETICS INC	11	12	302	.	.	.	.	.	38.8%	81.7%	ZF	ZF-
EDGE PETROLEUM CORP	10	11	340	.	.	.	.	.	38.4%	65.7%	ZF	ZF
FOAMEX INTERNATIONAL INC	2	11	729	.	.	.	.	.	48.0%	78.8%	ZF	ZF-
HARTMARX CORP	1	12	232	.	.	.	.	.	5.7%	27.4%	ZD-	ZD
MAGNA ENTERTAINMENT CORP	3	13	880	.	.	.	.	.	52.4%	78.1%	ZF-	ZF
MIDWAY GAMES INC	2	11	184	.	.	.	.	.	11.8%	58.5%	ZF+	ZF+
MONACO COACH CORP	3	13	238	.	.	.	.	.	0.3%	3.2%	ZC+	ZB
NORTEL NETWORKS CORP	1	11	13480	.	.	.	.	.	5.5%	36.0%	ZD-	ZD-
OSCIENT PHARMACEUTICALS CO	7	11	303	.	.	.	.	.	22.2%	69.6%	ZF+	ZF
PACIFIC ETHANOL INC	5	12	273	.	.	.	.	.	7.1%	31.3%	ZD-	ZD-
PROLIANCE INTERNATIONAL INC	7	11	146	.	.	.	.	.	8.7%	40.0%	ZD-	ZD-
SUN-TIMES MEDIA GROUP INC	3	12	867	.	.	.	.	.	21.6%	62.8%	ZF+	ZF+
TRANSMERIDIAN EXPL INC	3	12	335	.	.	.	.	.	7.6%	42.8%	ZD-	ZD-
TXCO RESOURCES INC	5	12	180	.	.	.	.	.	0.2%	5.9%	ZC+	ZC+

Agency ratings (S&P or Moody's) and agency equivalent (AE) ratings: CCC/CC/C = 1, B- = 2, B = 3, B+ = 4, BB- = 5, BB = 6, BB+ = 7, BBB = 8, BBB= 9

. = not available, mostly because of missing data

Source: Standard&Poor's, Moody's and author compilations

FIGURE 16B

Out of sample comparison of default prediction results for 2009 defaults: Agency Ratings, *Private* Z-Metrics™ and Z-score Agency Equivalent (AE) Ratings, Private Z-Metrics™ Ratings and Probabilities of Default data are from one year prior to default.

Company	Month of default in 2009	Ratings &PD Data (months before default)	total liabilities ($ mio)	Agency rating	Agency Equivalent (AE) Ratings				Z-Metrics PD values		Z-Metrics Ratings	
					Z-Metrics models		Z-score models					
					1y private macro	5y private	Z score	Z" score	1y private macro	5y private	1y private macro	5y private
ACCURIDE CORP	10	11	840	4	4	4	5	5	5.7%	12.1%	ZD-	ZC-
ALLIS-CHALMERS ENERGY INC	6	13	639	3	.	.	5	6	.	.	.	.
AMERICAN ACHIEVEMENT CORP	2	13	336	3	4	3	.	.	2.0%	14.0%	ZD+	ZD+
AVENTINE RENEWABLE ENERGY	4	11	408	4	6	5	9	8	0.6%	7.8%	ZC	ZC
BEAZER HOMES USA INC	9	13	2606	3	4	5	.	.	1.5%	7.4%	ZD+	ZC
BUILDING MATERIALS HLDG CP	6	13	613	2	2	2	9	5	9.9%	32.3%	ZD-	ZD-
CARAUSTAR INDUSTRIES INC	5	12	432	2	2	2	5	3	6.8%	32.8%	ZD-	ZD-
CHAMPION ENTERPRISES INC	11	13	702	3	5	4	5	4	2.8%	11.9%	ZD+	ZC-
CHEMTURA CORPORATION	3	13	2563	7	6	5	4	4	0.5%	6.3%	ZC	ZC
COMMERCIAL VEHICLE GROUP INC	8	13	334	4	9	6	6	6	0.3%	5.0%	ZB-	ZC+
DAYTON SUPERIOR CORP	4	11	407	3	2	1	3	2	6.5%	47.0%	ZD-	ZF+
EDDIE BAUER HOLDINGS INC	6	13	555	2	3	3	3	2	4.4%	26.0%	ZD	ZD
ENERGY FUTURE HOLDINGS CORP	11	12	57099	2	1	2	.	.	45.6%	33.4%	ZF-	ZD-
ENERGY PARTNERS LTD	4	11	713	3	2	2	3	2	8.2%	30.7%	ZD-	ZD-
FAIRPOINT COMMUNICATIONS INC	10	11	735	6	4	3	2	3	4.3%	16.5%	ZD	ZD+
FINLAY ENTERPRISES INC	8	12	624	1	2	2	5	5	7.0%	25.5%	ZD-	ZD
FINLAY FINE JEWELRY CORP	6	12	631	1	3	3	.	.	3.0%	19.1%	ZD	ZD+
FLEETWOOD ENTERPRISES INC	3	12	619	1	1	1	6	2	16.9%	51.6%	ZF+	ZF+
FORD MOTOR CO	4	12	272215	3	3	4	2	2	4.7%	10.8%	ZD	ZC-
FREESCALE SEMICONDUCTOR INC	3	12	11927	4	2	2	.	.	15.3%	29.7%	ZF+	ZD
GENERAL MOTORS CORP	6	10	184363	2	1	2	1	1	21.4%	33.9%	ZF	ZD-
GEORGIA GULF CORP	7	11	2005	1	1	2	5	4	11.1%	31.0%	ZF+	ZD-
HEXION SPECIALTY CHEMICALS	3	12	5380	3	3	3	.	.	4.7%	24.6%	ZD	ZD
HOVNANIAN ENTRPRS INC -CL A	7	13	3155	2	1	1	.	.	14.7%	38.2%	ZF+	ZD-
IDEARC INC	3	13	10267	6	5	4	9	7	0.7%	8.9%	ZC-	ZC-
LEAR CORP	6	11	6683	4	5	5	7	4	0.8%	7.7%	ZC-	ZC
LIBBEY INC	11	12	806	3	4	4	4	4	3.6%	14.0%	ZD	ZD+
MILACRON INC	3	13	652	1	1	1	3	2	16.6%	50.3%	ZF+	ZF+

Agency ratings (S&P or Moody's) and agency equivalent (AE) ratings: CCC/CC/C = 1, B- = 2, B = 3, B+ = 4, BB- = 5, BB = 6, BB+ = 7, BBB = 8, BBB= 9

. = not available, mostly because of missing data

FIGURE 16B CONT'D

Company	Month of default in 2009	Ratings &PD Data (months before default)	total liabilities ($ mio)	Agency rating	Agency Equivalent Ratings				Z-Metrics PD values		Z-Metrics Ratings	
					Z-Metrics models		Z-score models					
					1y private macro	5y private	Z score	Z" score	1y public macro	5y private	1y private macro	5y private
R H DONNELLEY CORP	5	12	14266	4	4	4	2	3	2.1%	10.7%	ZD+	ZC-
SMURFIT-STONE CONTAINER CO	1	12	5532	4	.	.	4	3	.	.	.	.
SOURCE INTERLINK COS INC	4	12	1996	3	3	3	4	3	4.0%	16.2%	ZD	ZD+
SPANSION INC	1	12	2183	3	3	3	3	3	4.2%	16.5%	ZD	ZD+
SPECTRUM BRANDS INC	2	12	3315	1	2	2	3	4	10.7%	31.2%	ZF+	ZD-
TLC VISION CORP	12	13	160	3	3	3	1	1	6.9%	19.0%	ZD-	ZD+
TRONOX INC	1	11	1294	4	3	3	4	4	4.0%	21.5%	ZD	ZD
UNISYS CORP	7	12	3771	4	4	3	3	2	1.6%	15.6%	ZD+	ZD+
VISTEON CORP	5	13	7002	3	2	2	4	3	11.4%	29.5%	ZF+	ZD
YOUNG BROADCASTING -CL A	2	11	951	1	1	1	2	4	39.3%	67.9%	ZF-	ZF-
defaulted firms with no actual S&P(Moody's) rating available in database - 12 months prior to default												
AURORA OIL & GAS CORP	7	11	122	.	.	.	.	.	4.7%	23.0%	ZD	ZD
BARZEL INDUSTRIES INC	9	11	557	.	.	.	.	.	8.2%	29.3%	ZD-	ZD
BEARINGPOINT INC	2	12	2451	.	.	.	.	.	24.6%	56.6%	ZF	ZF
CALIFORNIA COASTAL CMNTYS	10	11	266	.	.	.	.	.	27.2%	41.9%	ZF	ZD-
DECODE GENETICS INC	11	12	302	.	.	.	.	.	29.1%	56.9%	ZF-	ZF
EDGE PETROLEUM CORP	10	11	340	.	.	.	.	.	7.9%	13.9%	ZD-	ZD+
FOAMEX INTERNATIONAL INC	2	11	729	.	.	.	.	.	10.6%	53.0%	ZF+	ZF+
HARTMARX CORP	1	12	232	.	.	.	.	.	.	.	.	.
MAGNA ENTERTAINMENT CORP	3	13	880	.	.	.	.	.	21.8%	50.1%	ZF	ZF+
MIDWAY GAMES INC	2	11	184	.	.	.	.	.	41.8%	77.6%	ZF-	ZF-
MONACO COACH CORP	3	13	238	.	.	.	.	.	0.1%	1.7%	ZA-	ZA-
NORTEL NETWORKS CORP	1	11	13480	.	.	.	.	.	3.4%	20.5%	ZD	ZD+
OSCIENT PHARMACEUTICALS CO	7	11	303	.	.	.	.	.	21.3%	66.4%	ZF	ZF
PACIFIC ETHANOL INC	5	12	273	.	.	.	.	.	6.3%	26.5%	ZD-	ZD
PROLIANCE INTERNATIONAL INC	7	11	146	.	.	.	.	.	8.3%	41.0%	ZD-	ZD-
SUN-TIMES MEDIA GROUP INC	3	12	867	.	.	.	.	.	1.7%	18.3%	ZD+	ZD+
TRANSMERIDIAN EXPL INC	3	12	335	.	.	.	.	.	12.9%	45.9%	ZF+	ZF+
TXCO RESOURCES INC	5	12	180	.	.	.	.	.	0.3%	6.0%	ZC+	ZC+

Agency ratings (S&P or Moody's) and agency equivalent (AE) ratings: CCC/CC/C = 1, B- = 2, B = 3, B+ = 4, BB- = 5, BB = 6, BB+ = 7, BBB = 8, BBB= 9

. = not available, mostly because of missing data

Source: Standard&Poor's, Moody's and author compilations

FIGURE 17

Defaulted firms' corporate Agency ratings compared with Z-Metrics and Z-scores Agency equivalent ratings
(Comparison is made approximately 1 year prior to default)

		Credit scoring model					
		Z-Metrics 1y public macro	Z-Metrics 1y private macro	Z-Metrics 5y public	Z-Metrics 5y private	Z-score	Z"-score
IN SAMPLE: issuers defaulted in 1989 - 2008							
Agency Rating minus AE Rating	average	0.62	0.05	0.60	0.15	-0.90	-0.81
	minimum	8	9	7	9	9	9
	maximum	-7	-11	-5	-9	-12	-11
% Firms with higher Agency rating		51%	40%	51%	40%	34%	31%
% Firms with lower Agency rating		24%	34%	24%	30%	50%	50%
% Firms with equal rating		25%	26%	26%	30%	17%	19%
Total number of firms		402	535	402	535	451	451
OUT OF SAMPLE: issuers defaulted in 2009							
Agency Rating minus AE Rating	average	0.50	-0.14	0.47	0.03	-1.31	-0.62
	minimum	3	2	2	3	4	3
	maximum	-3	-5	-2	-2	-7	-4
% Firms with higher Agency rating		50%	31%	50%	28%	17%	28%
% Firms with lower Agency rating		19%	31%	16%	33%	66%	52%
% Firms with equal rating		31%	39%	34%	39%	17%	21%
Total number of firms		32	36	32	36	29	29

Source: Standard & Poor's, Moody's and author compilation.

Sovereign Default Risk Assessment: A Z-Metrics Application from the Bottom-Up

Periodically, sovereign economic conditions spiral out of control and require a massive debt restructuring and/or bailout accompanied by painful austerity programs for the country to function again in world commercial and financial markets. Recent instances have involved several Latin American countries in the 1980s, Southeast Asian nations in the late 1990s, Russia in 1998 and Argentina in 2000. These are examples of situations when a nation's severe problems not only impacted their own people and markets but created seismic financial tremors which extended beyond their borders. We are now experiencing this with the situation in Greece and several of its southern European neighbors.

The dire condition of these nations usually first manifests as a surprise to most, including the agencies that rate the default risk of sovereigns and the companies that reside in these suddenly threatened nations. It was not long ago that Greek debt was investment grade. In 1996, South Korea was considered one of the so-called "Asian Tigers" with an AA- rating, one of the best credit ratings possible. Within one year, South Korea was downgraded to BB-, one of the so-called "junk" rating categories and would have defaulted if not for a $50 billion bailout from the IMF.

Academics and market practitioners have not had an impressive record of predicting serious financial downturns or of providing adequate early warnings of impending sovereign economic and financial problems. These analysts generally use the traditional macroeconomic indicators, such as GDP growth, debt levels relative to GDP, trade and financial deficits, unemployment, productivity, and so on. While no guarantee of providing the magic formula for early warning transparency of impending doom, we believe that one can learn a great deal about sovereign risk by analyzing the health and aggregate default risk of a nation's private corporate sector - - a type of bottom-up analysis. Models such as the Z-Metrics system can provide an important additional measure of sovereign vulnerability.

Given the Z-Metrics default probabilities, one can compute both a median default probability and a score for each country and use these as an assessment of the overall health of the nation's private sector. As a basis for this conclusion, we can draw from the observation that at the end of 1996, the Z-Score tests showed that South Korea was the riskiest country in all of Asia, prior to the beginning of the Asian crisis in Thailand that eventually spread east to cover most countries. Thailand and Indonesia followed Korea closely as the next most vulnerable countries. While the Z-Scores showed that Korea had become risky, as noted above, it was still considered to be an excellent credit by traditional methods.

The current situation in Europe is also instructive. In a recent test of default probabilities using the Z-Metrics measure (see Figure 18), Greece has the most risky and least healthy private sector profile with a five-year median cumulative default probability of over 1,000 basis points (10.60%), followed by Portugal (9.36%), Italy (7.99%), and Spain (6.44%). Germany and France display a moderate overall credit risk cohort (5.5%) with the U.K. (perhaps a surprise) and the Netherlands rounding out our survey as the least risky corporate sectors. By comparison, the U.S. and Canada also display healthy metrics. With the most notable exception of Greece, our 5-year median PDs "cumulative default probability" for corporates are quite close to the PD for sovereigns. PDs for sovereigns are derived from the credit default swap (CDS) market's 5-year contract over the first three months in 2010. The CDS market's PD assessment for Greece is more than twice our median PD for its corporate sector. Differences can also be observed for the U.K. and Spain, although at lower PD levels. Of course, 50% of the corporations in all countries have PDs greater than the median.

So, in prescribing difficult sanctions to governments for them to qualify for bailouts and subsidies, we should be careful to promote, not destroy, private enterprise valuations. A healthy corporate sector can provide valuable tax revenues for the sovereign. Improving corporate health can be an early indicator of a return to health of the sovereign as well as an early warning of impending problems when the trend is negative and the PDs are high.

FIGURE 18

Financial Health of the Private Sector of Selected Countries: The Z-Metrics Assessment

Country	Num of Listed Companies	Five-Year Public Model•			Median PD from CDS Spreads†	One-Year Public Model•		
		Median PD	Std. Dev. PDs	Median Rating	Five Year	Median PD	Std. Dev. PDs	Median Rating
Netherlands	61	3.33%	7.52%	ZB	2.83%	0.153%	1.020%	ZB-
United Kingdom	442	3.62%	11.60%	ZB-	6.52%	0.218%	2.580%	ZC+
Canada	368	3.70%	12.20%	ZB-	4.15%	0.164%	3.350%	ZB-
U.S.A.	2236	3.93%	9.51%	ZB-	3.28%	0.139%	2.320%	ZB
France	297	5.51%	9.72%	ZC+	3.75%	0.290%	2.060%	ZC+
Germany	289	5.54%	13.10%	ZC+	2.67%	0.268%	3.960%	ZC+
Spain	82	6.44%	9.63%	ZC	9.39%	0.363%	1.360%	ZC
Italy	155	7.99%	10.20%	ZC	8.69%	0.493%	1.650%	ZC
Portugal	30	9.36%	7.25%	ZC-	10.90%	0.482%	0.827%	ZC
Greece	79	10.60%	14.40%	ZC-	24.10%	0.935%	3.660%	ZC-

•Based on Z-Metrics PDs from January 1, 2010 to April 1, 2010

†Assuming a 40% recovery rate, based on CDS Spreads observed from January 1, 2010 to April 1, 2010. PD computed as $1-e^{(-5*s/(1-R))}$

Sources: RiskMetrics Group, 2010; Markit; Compustat