

# A Novel Approach to Assess Sovereign Risk from the Bottom Up

Dr. Edward I. Altman – Stern School of Business  
New York University

*Presented by*



**CEDAR**  
WE MAKE STRATEGY WORK

## **The Cedar Edward Altman Event**

Rooftop, Trident, Nariman Point – Mumbai  
January 27, 2011

*Partners*

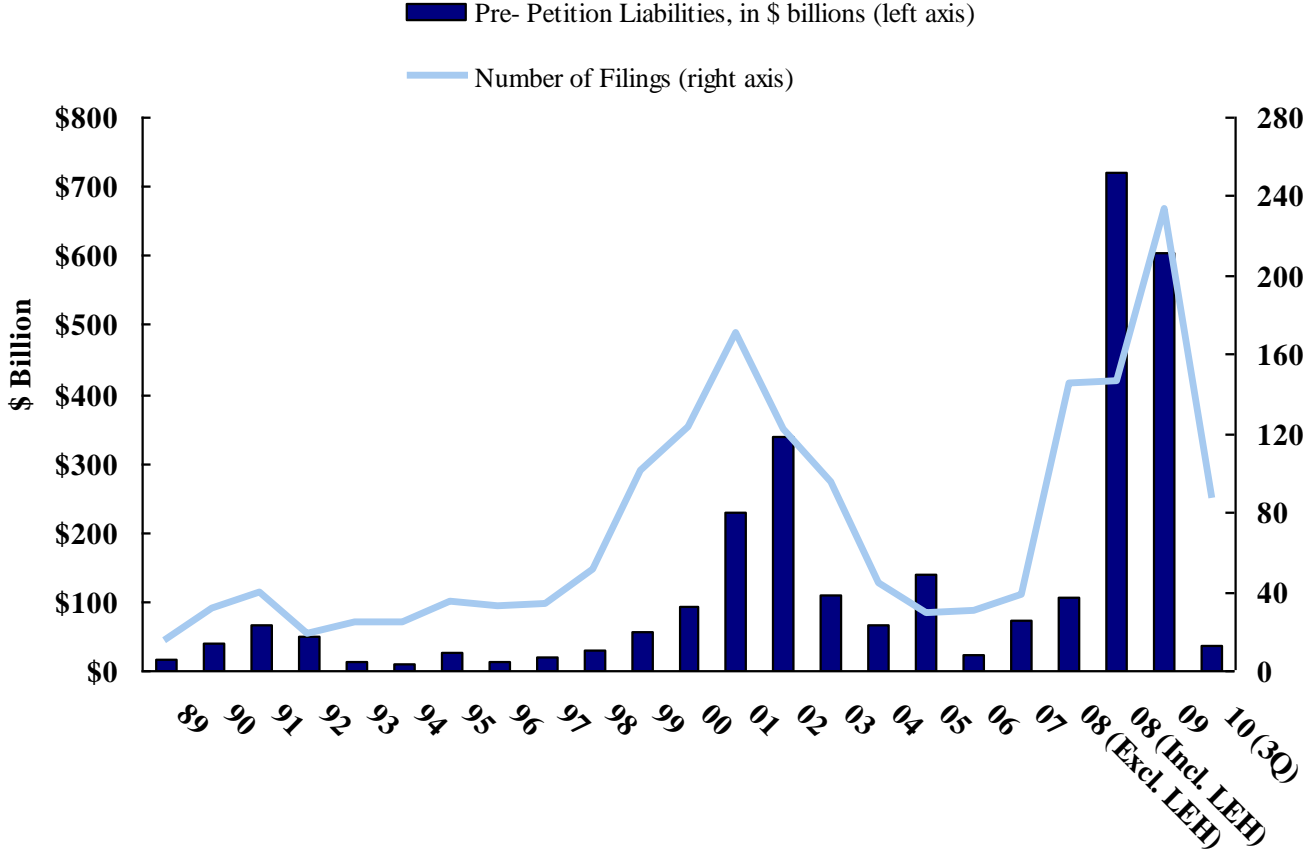


# Measuring and Assessing Sovereign Risk

(Outline for Discussion)

- Current Conditions in Credit Markets in U.S.
- Some Recent Sovereign Crises
  - Asia – 1997
  - Argentina – 2000
  - Europe – 2010
- Traditional Indicators of Risk
  - Macroeconomic Related Variables
- Traditional Models
  - Statistical and Aggregative Techniques
- Newer Market Based Techniques and Measures
  - Contingent Claims Structural Approach
  - Credit Default Swaps (CDS) Implied Probability of Defaults (PDs)
- Corporate Statistical PD Measures to Assess Sovereign Health
  - The Z-Metrics Approach
  - A Bottom-Up analysis

# Total filings and liabilities of companies filing for Chapter 11 Protection in the US: 1989-2010 (3Q)



**2009**  
 234 filings and liabilities of \$604.0 billion

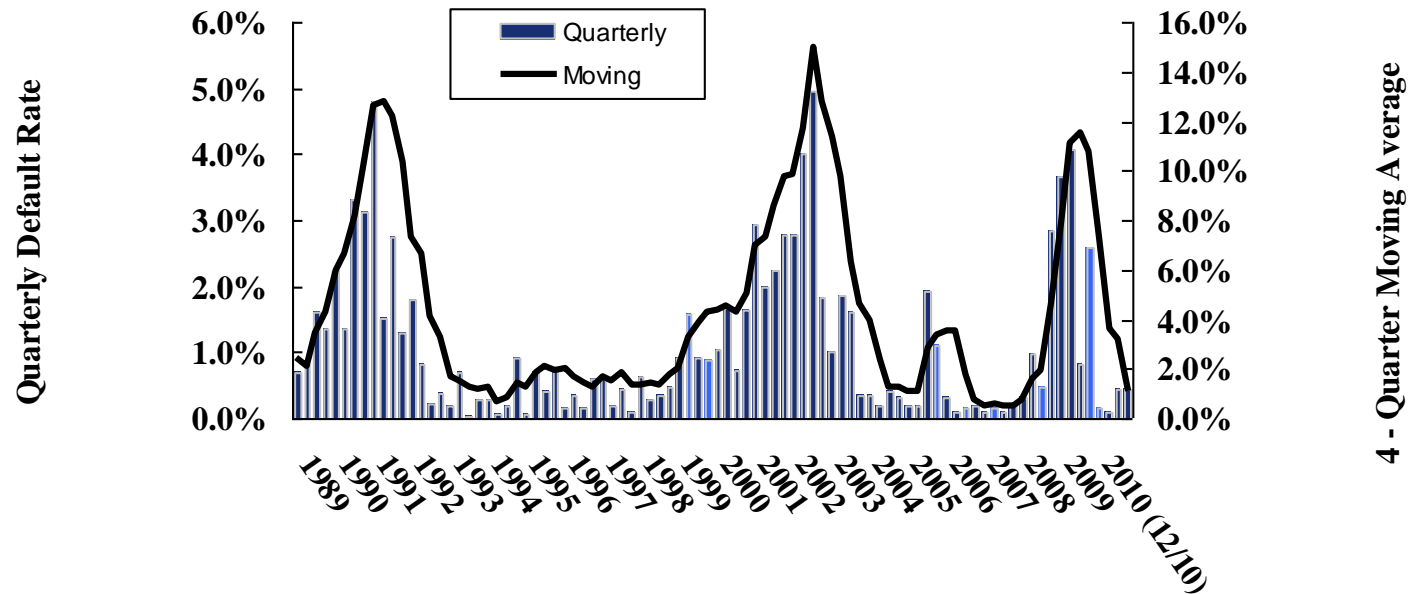
**2010 (3Q)**  
 87 filings and liabilities of \$37.8 billion

Source: NYU Salomon Center Bankruptcy Filings Database

# Default rates on high-yield bonds 1989-2010 (12/10)

## QUARTERLY DEFAULT RATE AND FOUR QUARTER MOVING AVERAGE

1989 – 2010 (12/10)



Source: Author's Compilations

# Historical Default Rates



Straight Bonds Only Excluding Defaulted Issues From Par Value Outstanding, (US\$ millions)  
1971 – 2010 (12/10)

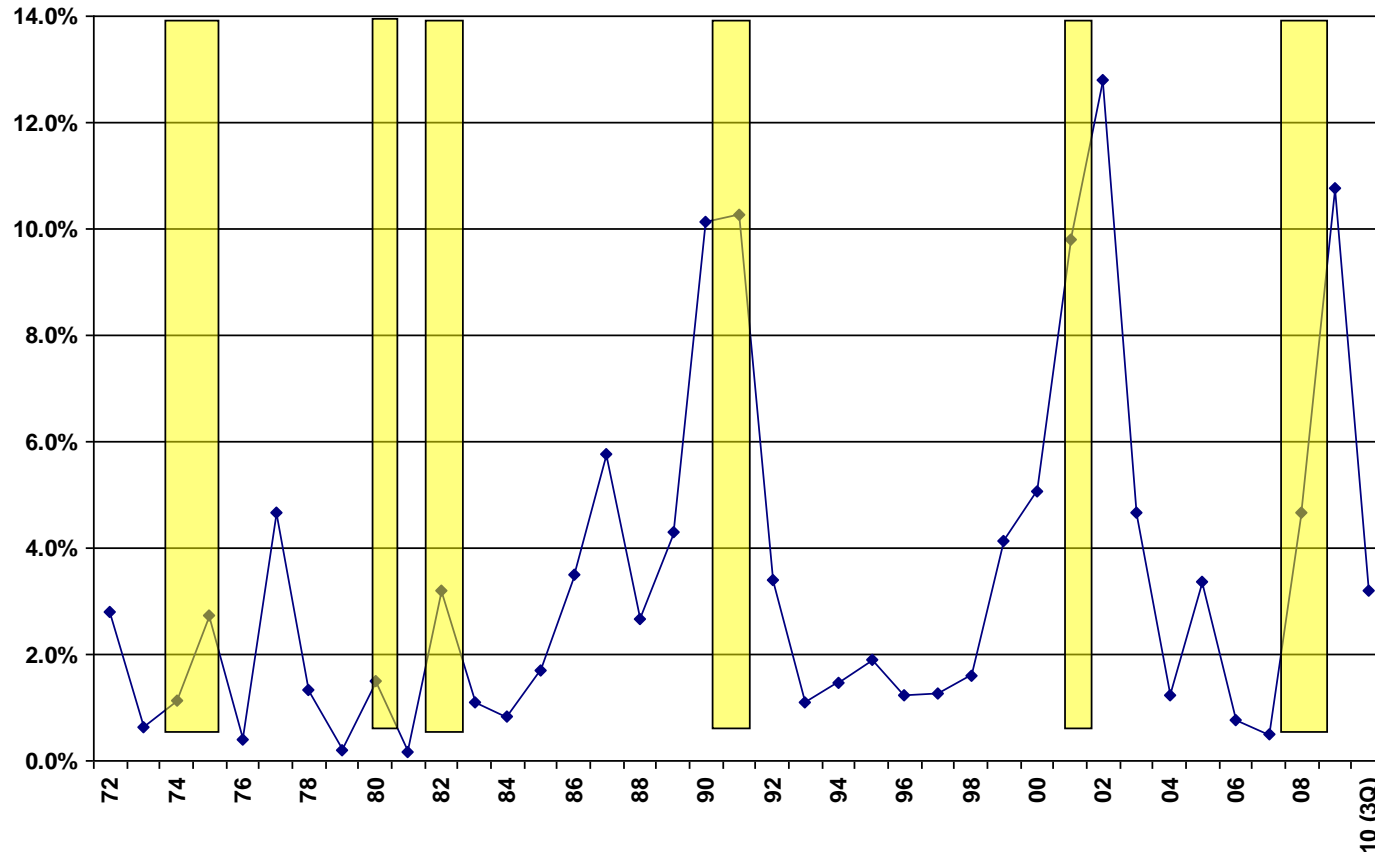
Year	Par Value Outstanding*	Par Value Defaults	Default Rates (%)	Year	Par Value Outstanding <sup>a</sup>	Par Value Defaults	Default Rates (%)
<b>2010 (12/10)</b>	<b>\$1,221,569</b>	<b>\$13,809</b>	<b>1.130%</b>	1984	\$40,939	\$344	0.840
2009	\$1,152,952	\$124,130	10.766	1983	\$27,492	\$301	1.095
2008	\$1,091,000	\$50,763	4.653	1982	\$18,109	\$577	3.186
2007	\$1,075,400	\$5,473	0.509	1981	\$17,115	\$27	0.158
2006	\$993,600	\$7,559	0.761	1980	\$14,935	\$224	1.500
2005	\$1,073,000	\$36,181	3.372	1979	\$10,356	\$20	0.193
2004	\$933,100	\$11,657	1.249	1978	\$8,946	\$119	1.330
2003	\$825,000	\$38,451	4.661	1977	\$8,157	\$381	4.671
2002	\$757,000	\$96,855	12.795	1976	\$7,735	\$30	0.388
2001	\$649,000	\$63,609	9.801	1975	\$7,471	\$204	2.731
2000	\$597,200	\$30,295	5.073	1974	\$10,894	\$123	1.129
1999	\$567,400	\$23,532	4.147	1973	\$7,824	\$49	0.626
1998	\$465,500	\$7,464	1.603	1972	\$6,928	\$193	2.786
1997	\$335,400	\$4,200	1.252	1971	\$6,602	\$82	1.242
1996	\$271,000	\$3,336	1.231	<b>Standard Deviation (%)</b>			
1995	\$240,000	\$4,551	1.896	<b>Arithmetic Average Default Rate</b>			
1994	\$235,000	\$3,418	1.454	1971 to 2009		3.332%	3.226%
1993	\$206,907	\$2,287	1.105	1978 to 2009		3.637%	3.424%
1992	\$163,000	\$5,545	3.402	1985 to 2009		4.323%	3.550%
1991	\$183,600	\$18,862	10.273	<b>Weighted Average Default Rate*</b>			
1990	\$181,000	\$18,354	10.140	1971 to 2009		4.552%	
1989	\$189,258	\$8,110	4.285	1978 to 2009		4.564%	
1988	\$148,187	\$3,944	2.662	1985 to 2009		4.601%	
1987	\$129,557	\$7,486	5.778	<b>Median Annual Default Rate</b>			
1986	\$90,243	\$3,156	3.497	1971 to 2009		1.896%	
1985	\$58,088	\$992	1.708				

\* Weighted by par value of amount outstanding for each year.

Source: Author's compilation and Citigroup estimate

# Historical Default Rates and Recession Periods in the U.S.

## HIGH YIELD BOND MARKET (1972 – 2010 (3Q\*))



Periods of Recession: 11/73 - 3/75, 1/80 - 7/80, 7/81 - 11/82, 7/90 - 3/91, 4/01 - 12/01, 12/07-6/09

\*All rates annual except for 3Q 2010, which is the LTM default rate.

Source: E. Altman (NYU Salomon Center) & National Bureau of Economic Research

## Objectives of our Z-Metrics™ model

- To construct an accurate, logical, and robust credit-scoring model
- To assign a probability of default (PD) and Z-Metrics unique credit rating over one-year and five-year horizons to non-financial firms
- To provide both “best estimate” as well as “stressed” PDs and ratings
- To create models for:
  - Large publicly-held firms in the U.S. and Canada (“U.S. Model”)
  - Large, privately-held firms in the U.S. and Canada
  - Small, publicly-held firms in the U.S. and Canada
  - Large and small firms outside the U.S. and Canada
- We expect that our U.S. model will be applicable to ex-U.S. firms

## Model characteristics



- Based on over 1,000 U.S./Canadian defaulted (credit-event) non-financial firms and a control sample (~15:1) of non-defaulting observations
- Credit-event date is default or bankruptcy date—whichever occurs first
- Credit-event sample reduced to 638 firms in public firm sample and 802 in private firm sample after removing those with insufficient data
- Sample period 1989-2008, out-of-sample tests based on two 10-year samples and 2009 credit-event firms

## Model characteristics (continued)



- Over 260,000 quarterly & annual observations used to construct model
- Macroeconomic factors included to capture time-series variation of default probabilities
- For stressed ratings and PDs, two critical measures are examined: Share price and earnings
- Final public model has 12 fundamental and market variables, including both static and trend measures plus two macroeconomic variables

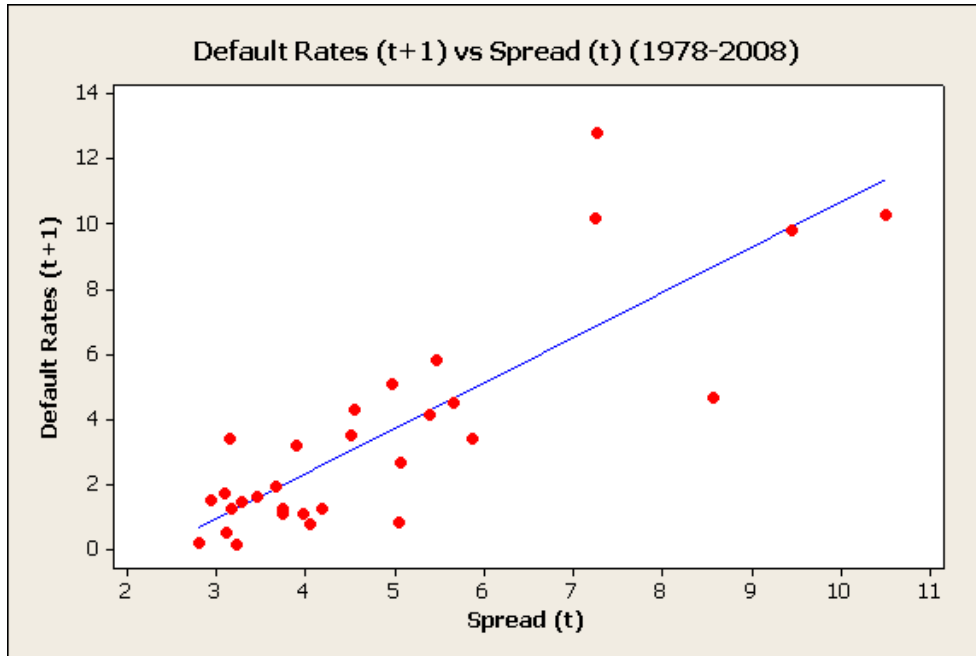
## Variables assessed



- 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
- Analyzed trends in many of the fundamental variables
- Included equity market price and return variables and their relative volatility patterns: typically used in structural, distance-to-default measures
- Examined distribution of variable values: transformed variables to capture nature of distribution and to reduce influence of outliers
- Supplemented fundamentals and market data with macroeconomic measures to adjust for macro stresses on the world's economies

# Dollar Denominated (Altman) Default Rate Predictions

## Case 1: Default Rate[t+1] Versus Yield Spread[t]



The regression equation is

$$\text{Default Rate} = -3.25 + 1.39 * \text{Spread}$$

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%

### Application

- Applying Yield spread (12/31/2008) of 1,731 bps,  $P_D = -3.25 + 1.39 * 17.31 = 20.811\%$
- Applying Yield spread (12/31/2009) of 513 bps,  $P_D = -3.25 + 1.39 * 5.13 = 3.883\%$
- Applying Yield spread (6/30/2010) of 622 bps,  $P_D = -3.25 + 1.39 * 6.22 = 5.398\%$

# Logit model estimation

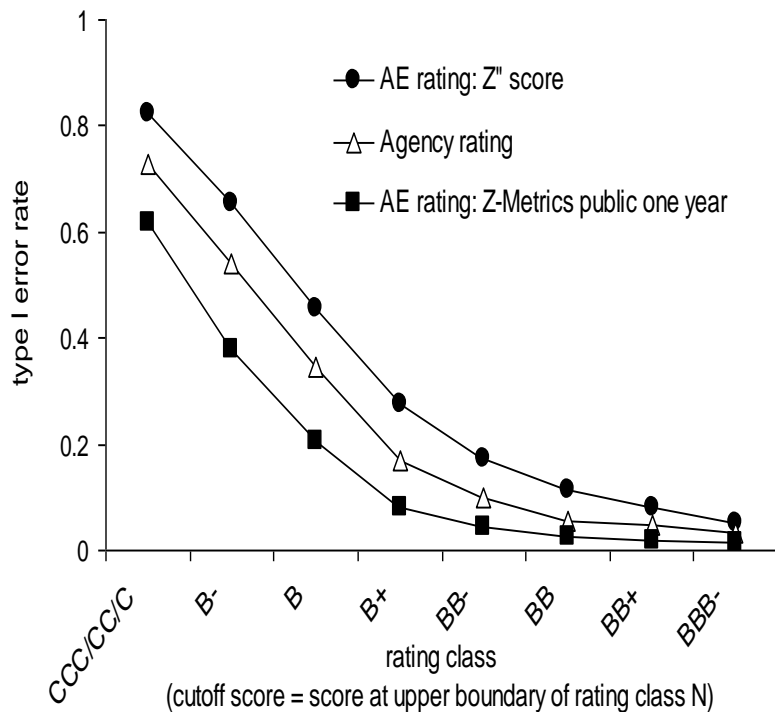
- Standard logit regression functional form
- $CS_{i,t} = \alpha + \sum \beta X_{i,t} + \varepsilon_{i,t}$
- $CS_{i,t}$  = Z-Metrics credit score of company i at time t
- $\beta$  = variable parameters (or weights)
- $X_{i,t}$  = set of fundamental, market based and macroeconomic variables for firm/quarter observations
- $\varepsilon_{i,t}$  = error terms (assumed to be identically and independently distributed)
- $CS_{i,t}$  is transformed into a probability of default by

$$PD_{i,t} = \frac{1}{1 + e^{CS_{i,t}}}$$

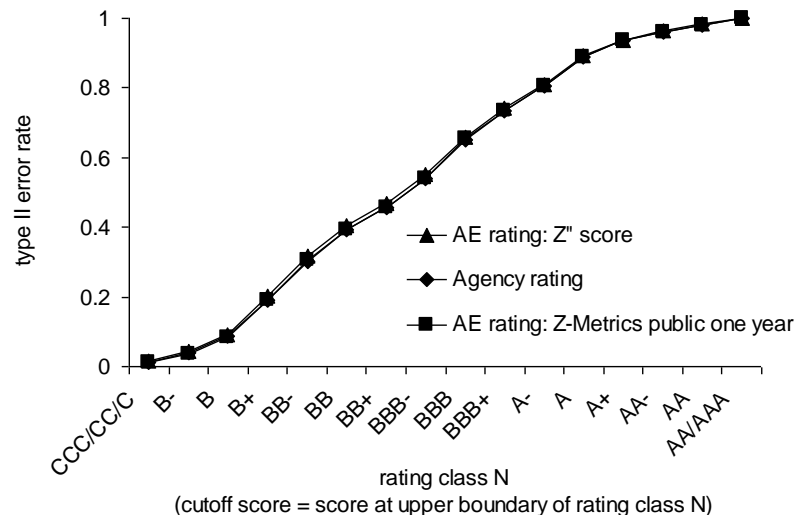
# Type I and Type II error rates for Agency ratings, Z-Metrics and Z''-score Agency Equivalent (AE) ratings (1989-2008): One year prediction horizon for public firms



type I error rate (defaulters classified as non-defaulters / total defaulters)



type II error rate (non defaulters classified as defaulters/total non defaulters)



# Definition of Z-Metrics ratings for one and five-year horizon

## Public Models



	<b>Z-Metrics <i>One-Year</i> Public Model</b>					<b>Z-Metrics <i>Five-Year</i> Public Model</b>			
	Rating	One Year PD		% Representation		Five Year PD		% Representation	
		Min	Max	1989/2008	2008	Min	Max	1989/2008	2008
High Grade	ZA+	0.00%	0.02%	3.50%	2.10%	0.00%	0.75%	3.40%	2.40%
	ZA	0.02%	0.04%	5.80%	4.60%	0.75%	1.25%	7.00%	5.40%
	ZA-	0.04%	0.06%	7.60%	6.10%	1.25%	1.75%	7.60%	6.40%
	ZB+	0.06%	0.09%	10.60%	10.00%	1.75%	2.50%	10.60%	9.90%
	ZB	0.09%	0.14%	10.90%	11.20%	2.50%	3.50%	11.10%	11.30%
	ZB-	0.14%	0.20%	8.80%	9.10%	3.50%	4.50%	8.10%	8.60%
Medium Grade	ZC+	0.20%	0.30%	9.40%	10.80%	4.50%	6.00%	8.60%	9.70%
	ZC	0.30%	0.50%	10.10%	10.40%	6.00%	9.00%	11.10%	12.10%
	ZC-	0.50%	1.00%	10.60%	11.40%	9.00%	14.00%	10.00%	10.30%
Low Grade	ZD+	1%	2%	7.60%	8.20%	14%	20%	6.30%	6.80%
	ZD	2%	4%	5.20%	5.80%	20%	30%	6.00%	6.60%
	ZD-	4%	10%	4.50%	4.70%	30%	45%	4.50%	4.90%
	ZF+	10%	25%	2.60%	2.60%	45%	65%	3.00%	3.20%
	ZF	25%	50%	1.50%	1.60%	65%	80%	1.40%	1.60%
	ZF-	50%	100%	1.20%	1.30%	80%	100%	1.00%	1.00%

# Financial Health of the Corporate, Non-Financial Sector: Selected European Countries and U.S.A. in 2010/2009

(Z-Metrics PD Estimates and Implied PDs from CDS Spreads)

Country	No. of Listed Companies 2010 2009		Z-Metrics PD Estimates: Five-Year Public Model*				Five-Year Implied PD from CDS Spread**†	
			2010 (1/1 – 4/30) Median PD	2009 (1/1 – 6/30) Median PD	2010 Std. Dev.	2009 Std. Dev.	2010 (1/1 - 4/30)	2009 (1/1 – 6/30)
			Netherlands	61	60	3.33%	5.62%	7.52%
U.K.	442	433	3.62%	5.75%	11.60%	12.70%	6.52%	8.13%
U.S.A.	2226	2171	3.93%	6.97%	9.51%	15.15%	3.28%	4.47%
France	297	294	5.51%	7.22%	9.72%	12.34%	3.75%	4.05%
Germany	289	286	5.54%	7.34%	13.10%	15.16%	2.67%	3.66%
Spain	82	78	6.44%	7.39%	9.63%	11.26%	9.39%	8.07%
Ireland	28	26	6.45%	7.46%	16.29%	16.30%	12.20%	17.00%
Italy	155	154	7.99%	10.51%	10.20%	14.11%	8.69%	11.20%
Portugal	30	30	9.36%	12.07%	7.25%	12.44%	10.90%	7.39%
Greece	79	77	10.60%	11.57%	14.40%	12.99%	24.10%	13.22%

\* Based on median Z-Metrics PDs from January 1 – June 30, 2009 and January 1 – April 30, 2010.

\*\*Assuming a 40% recovery rate; based on the median CDS spread observed for first six months of 2009 and first three months of 2010.

†PD Computed as  $1 - e^{-(5^*s)/(1-R)}$

# Median Percent Change in Various Country Stock Market Index Values and Z-Metrics' PDs

(First Six Months of 2010 Vs. 2009)

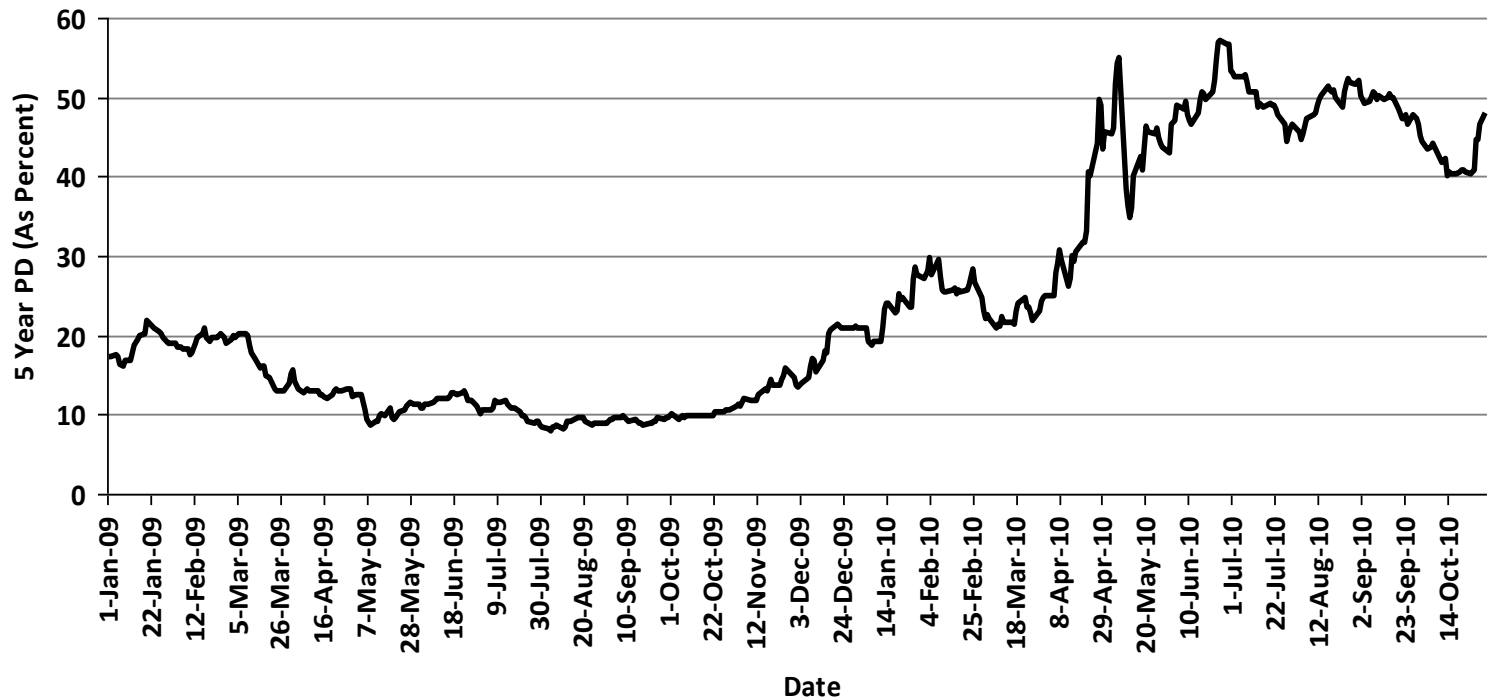
Country	Index	Median Percent Change (2010 vs. 2009)*	Median Z-Metrics PDs: Percent Change (2010 vs. 2009)*
France	CAC40	24.1%	-23.6%
Germany	DAX	31.8%	-24.5%
Greece	ASE	5.5%	-8.4%
Ireland	ISEQ	26.2%	-7.4%
Italy	FTSEMIB	18.2%	-24.0%
Netherlands	AEX	34.4%	-25.3%
Portugal	PSI-20	17.8%	-22.4%
Spain	IBEX35	20.9%	-12.9%
U.K.	FTSE100	27.8%	-37.6%
U.S.A.	S&P500	31.9%	-43.6%

\*Median of the various trading day stock index values and PDs

Sources: Z-Metrics Model calculations from RiskMetrics (MSCI) Group, Bloomberg for stock index values

# Five Year Implied Probabilities of Default (PD) From CDS Spreads

Greece, Jan 2009 - Oct 2010



Source: Markit

# Financial Health of the Corporate, Non-Financial Sector of Selected Asian Countries

(2010 Results)

Country	No. of Listed Companies	Z-Metrics Five Year Probability of Default			Five Year Implied PD from CDs Spread
		Median PD	Mean PD	Std. Dev. PD	
Hong Kong	135	2.79%	5.47%	6.92%	3.75%
India (State Bank of)	610	4.29%	7.56%	8.50%	12.47%
Singapore	202	3.46%	7.65%	10.58%	3.69%

Sources: Author Calculations from MSCI Group, Compustat Data

# Recent Five-Year Probability of Default (PD) Implied From CDS Spreads

(December 15, 2010 Results)

Country	Five Year Implied PD from CDs Spread
Netherlands	3.66%
United Kingdom	4.68%
USA	2.27%
France	6.65%
Germany	3.19%
Spain	19.45%
Ireland	33.67%
Italy	11.63%
Portugal	26.40%
Greece	51.79%

Sources: Author Calculations from MSCI Group, Compustat Data