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# Models for Predicting Financial Distress: Z-Score After 50 Years, What Have We Learned?

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Washington, D.C.  
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*Session 3*

# Major Agencies Bond Rating Categories

Moody's

S&P/Fitch

Aaa  
Aa1  
Aa2  
Aa3  
A1  
A2  
A3  
Baa1  
Baa2  
Baa3  
Ba1  
Ba2  
Ba3  
B1  
B2  
B3  
Caa1  
Caa  
Caa3  
Ca  
C

↑  
Investment  
Grade

AAA  
AA+  
AA  
AA-  
A+  
A  
A-  
BBB+  
BBB  
BBB-  
BB+  
BB  
BB-  
B+  
B  
B-  
CCC+  
CCC  
CCC-  
CC  
C  
D

High Yield  
("Junk")

↓

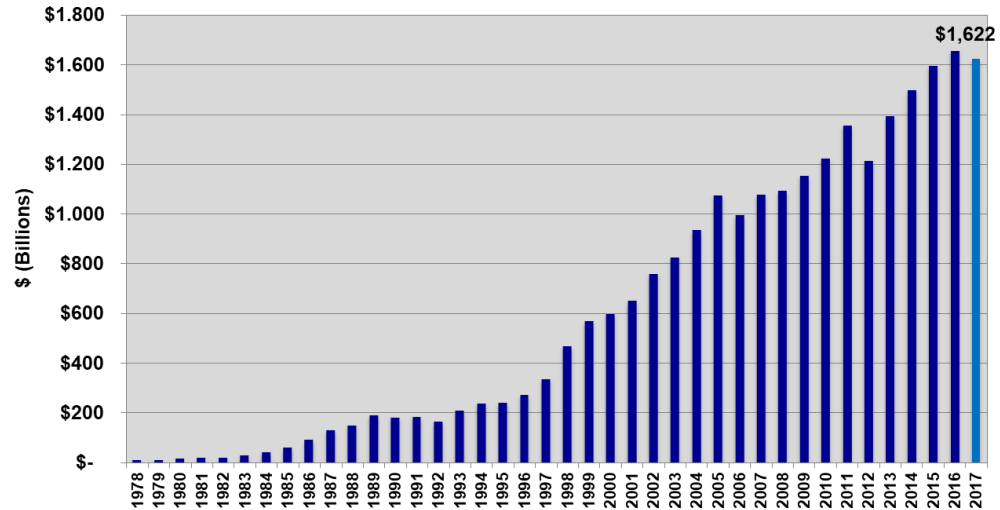
High Yield  
Market

# Size Of High-Yield Bond Market

## US Market



1978 – 2017 (Mid-year US\$ billions)

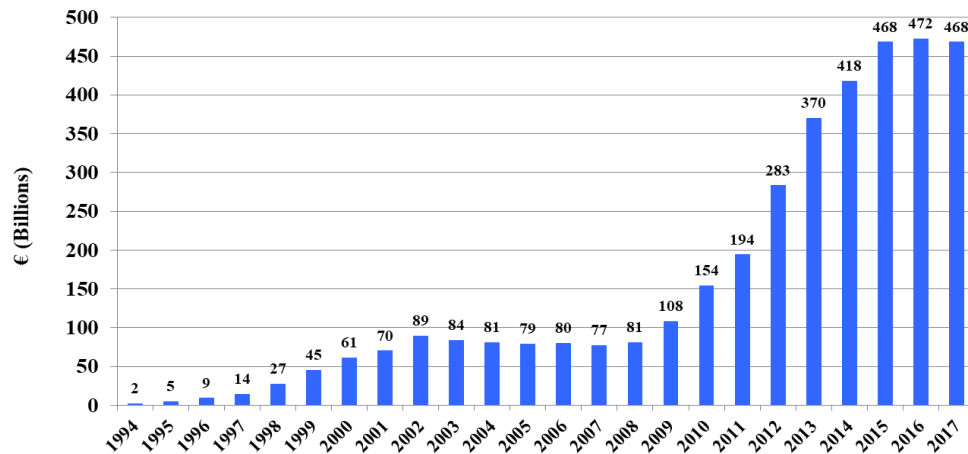


Source: NYU Salomon Center estimates using Credit Suisse, S&P and Citi data

## Western Europe Market



1994 – 2017 (Mid-year € billions)\*

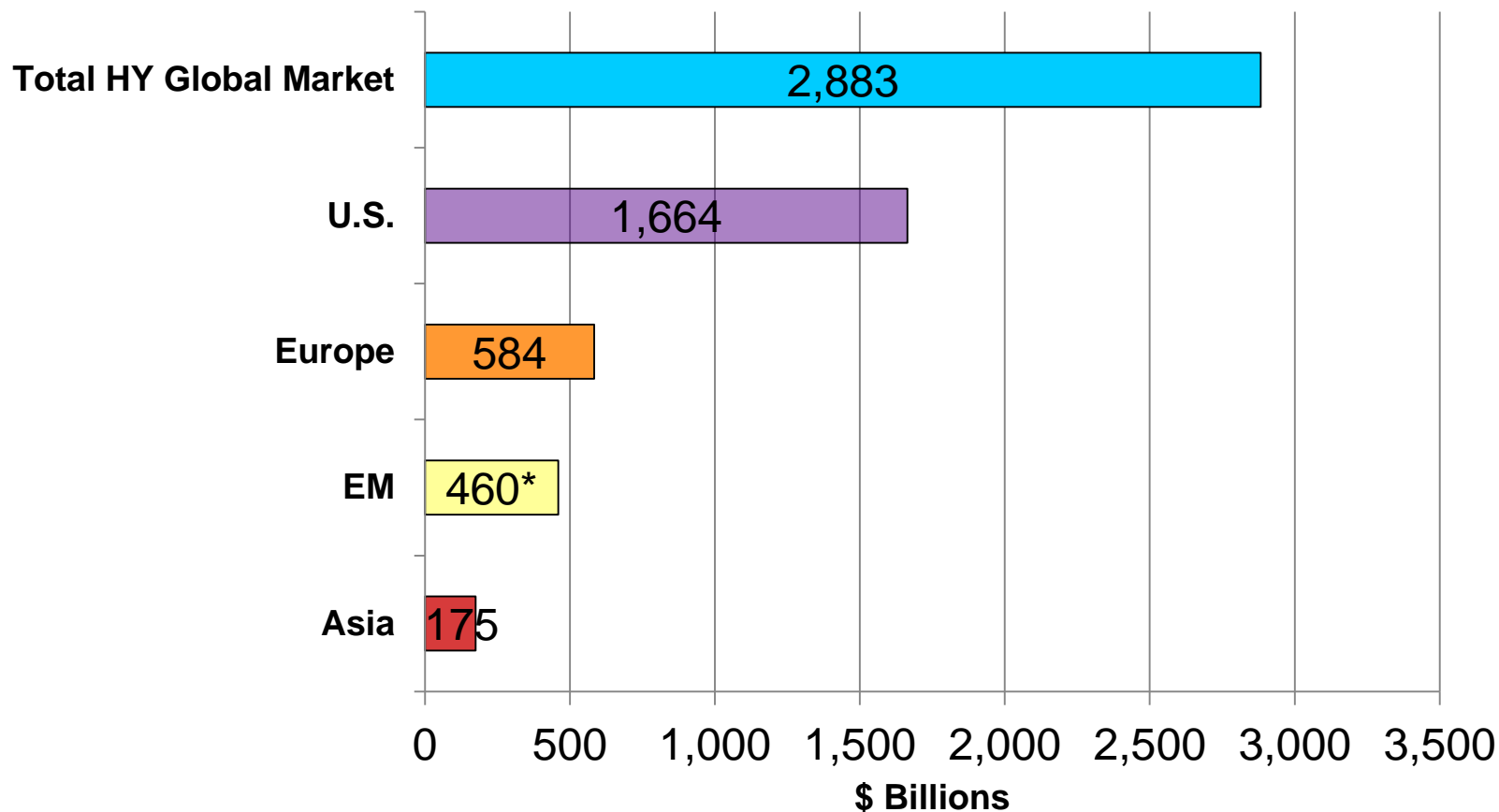


Source: Credit Suisse

\* Includes non-investment grade straight corporate debt of issuers with assets located in or revenues derived from Western Europe, or the bond is denominated in a Western European currency. Floating-rate and convertible bonds and preferred stock are not included.

# Size of Corporate HY Bond Market: U.S., Europe, Emerging Markets & Asia (ex. Japan) (\$ Billions)

2018 (1Q)

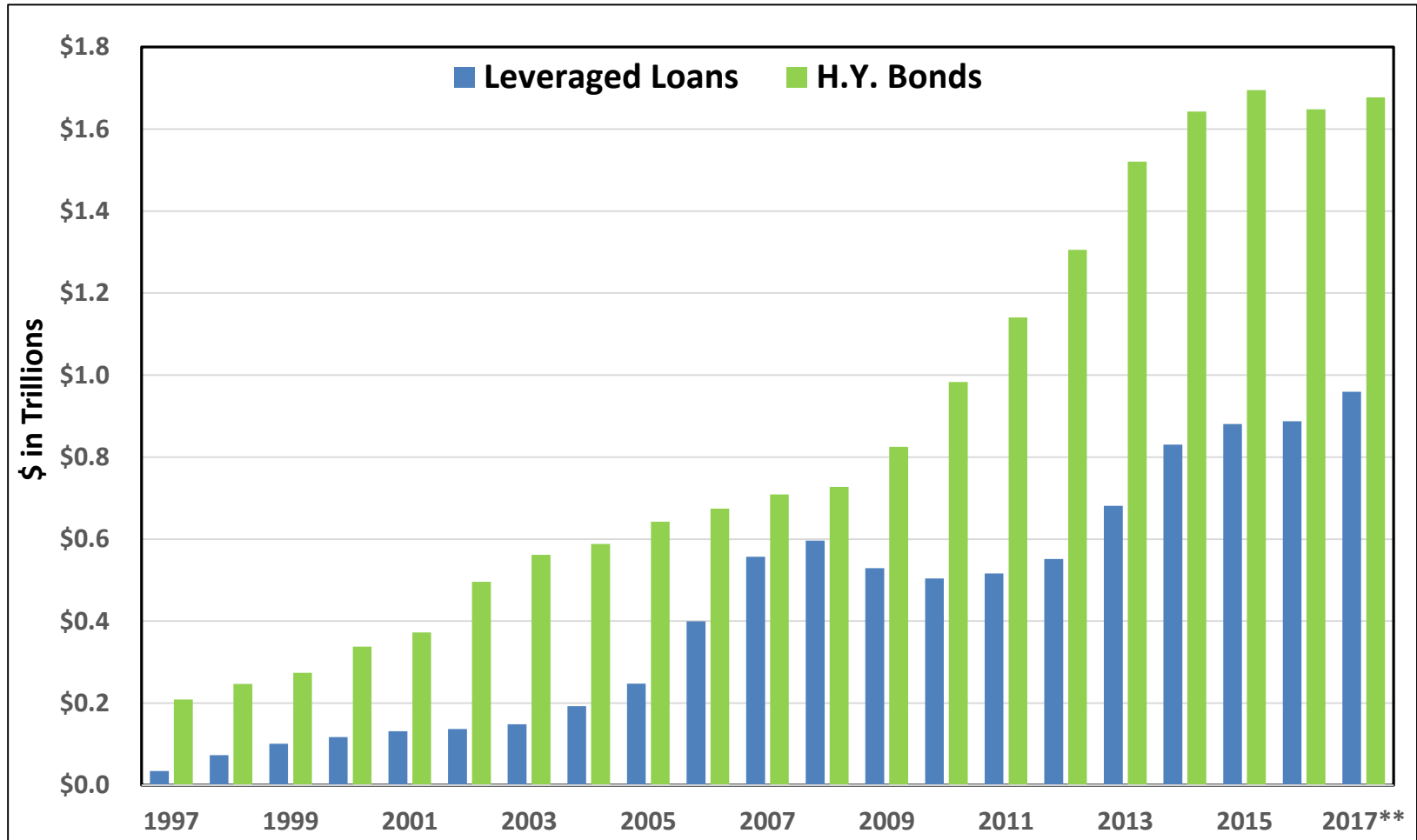


\*Mainly Latin America. Note: EM & Asia value as of 2017.

Source: NYU Salomon Center, Credit Suisse, LIM Advisors Ltd.

# Size of The U.S. High-Yield and Leveraged Loan\* Markets

1997-2017



\*Primarily Institutional Tranches. \*\*NYU Salomon Center High-Yield Market Size as of 12/31/17.

Source: S&P Global Market Intelligence.

# Benign Credit Cycle: Is It Over?

- **Length of Benign Credit Cycles: Is the Current Cycle Over? No.**
- **Default Rates (no), Default Forecast (no), Recovery Rates (no), Yields (no) & Liquidity (no)**
- **Coincidence with Recessions: U.S. & European Scenarios**
- **Level of Non-financial Debt as a Percent of GDP**
- **Global Debt Levels**
- **Comparative Health of High-Yield Firms (2007 vs. 2017)**
- **High-Yield CCC New Issuance as a Liquidity Measure**
- **LBO Statistics and Trends**
- **Liquidity Concerns (Market and Market-Makers)**
- **Possible Timing of the Bubble Burst (Short-term versus Longer-term)**

# Benign Credit Cycle? Is It Over?

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- **Length of Benign Credit Cycles: Is the Current Cycle Over? No.**
- **Default Rates (no), but Rising**
- **Default Forecast (no)**
- **Recovery Rates (no)**
- **Yields (no)**
- **Liquidity (no)**

# Historical H.Y. Bond Default Rates

Straight Bonds Only Excluding Defaulted Issues From Par Value Outstanding, (US\$ millions), 1971 – 2018 (5/07)

Year	Par Value Outstanding <sup>a</sup> (\$)	Par Value Defaults (\$)	Default Rates (%)
<b>2018 (5/07)</b>	<b>1,677,117</b>	<b>19,275</b>	<b>1.149</b>
2017*	1,622,365	29,301	1.806
2016	1,656,176	68,066	4.110
2015	1,595,839	45,122	2.827
2014	1,496,814	31,589	2.110
2013	1,392,212	14,539	1.044
2012	1,212,362	19,647	1.621
2011	1,354,649	17,963	1.326
2010	1,221,569	13,809	1.130
2009	1,152,952	123,878	10.744
2008	1,091,000	50,763	4.653
2007	1,075,400	5,473	0.509
2006	993,600	7,559	0.761
2005	1,073,000	36,209	3.375
2004	933,100	11,657	1.249
2003	825,000	38,451	4.661
2002	757,000	96,855	12.795
2001	649,000	63,609	9.801
2000	597,200	30,295	5.073
1999	567,400	23,532	4.147
1998	465,500	7,464	1.603
1997	335,400	4,200	1.252
1996	271,000	3,336	1.231
1995	240,000	4,551	1.896
1994	235,000	3,418	1.454
1993	206,907	2,287	1.105
1992	163,000	5,545	3.402
1991	183,600	18,862	10.273

Year	Par Value Outstanding* (\$)	Par Value Defaults (\$)	Default Rates (%)
1990	181,000	18,354	10.140
1989	189,258	8,110	4.285
1988	148,187	3,944	2.662
1987	129,557	7,486	5.778
1986	90,243	3,156	3.497
1985	58,088	992	1.708
1984	40,939	344	0.840
1983	27,492	301	1.095
1982	18,109	577	3.186
1981	17,115	27	0.158
1980	14,935	224	1.500
1979	10,356	20	0.193
1978	8,946	119	1.330
1977	8,157	381	4.671
1976	7,735	30	0.388
1975	7,471	204	2.731
1974	10,894	123	1.129
1973	7,824	49	0.626
1972	6,928	193	2.786
1971	6,602	82	1.242

		Standard Deviation (%)
<b>Arithmetic Average Default Rate (%)</b>		
1971 to 2017	3.104	3.006
1978 to 2017	3.308	3.160
1985 to 2017	3.759	3.280
<b>Weighted Average Default Rate (%)*</b>		
1971 to 2017	3.378	
1978 to 2017	3.381	
1985 to 2017	3.394	
<b>Median Annual Default Rate (%)</b>		
1971 to 2017	1.806	

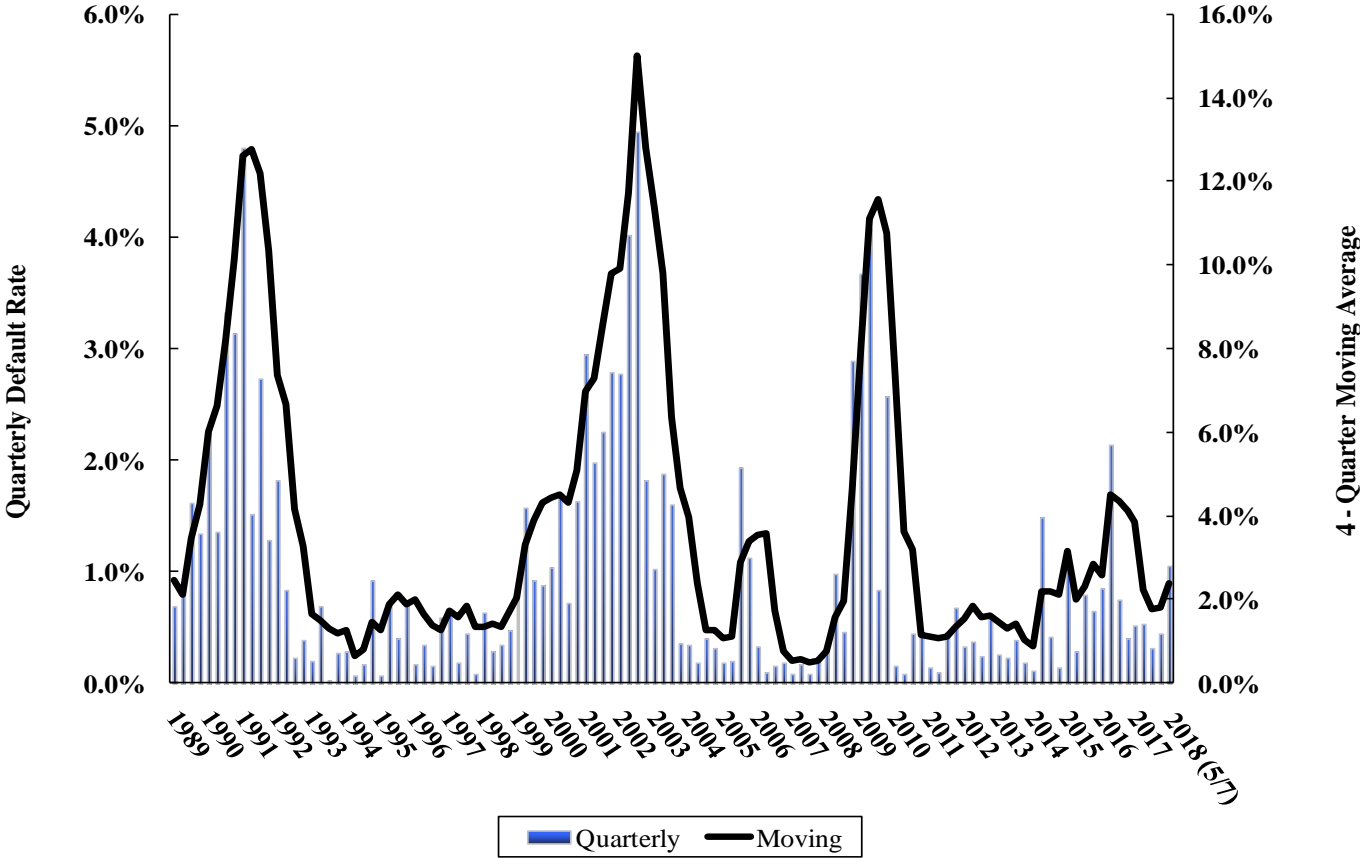
Source: NYU Salomon Center and Citigroup/Credit Suisse estimates

<sup>a</sup> Weighted by par value of amount outstanding for each year. \*Preliminary



# Default Rates on High-Yield Bonds

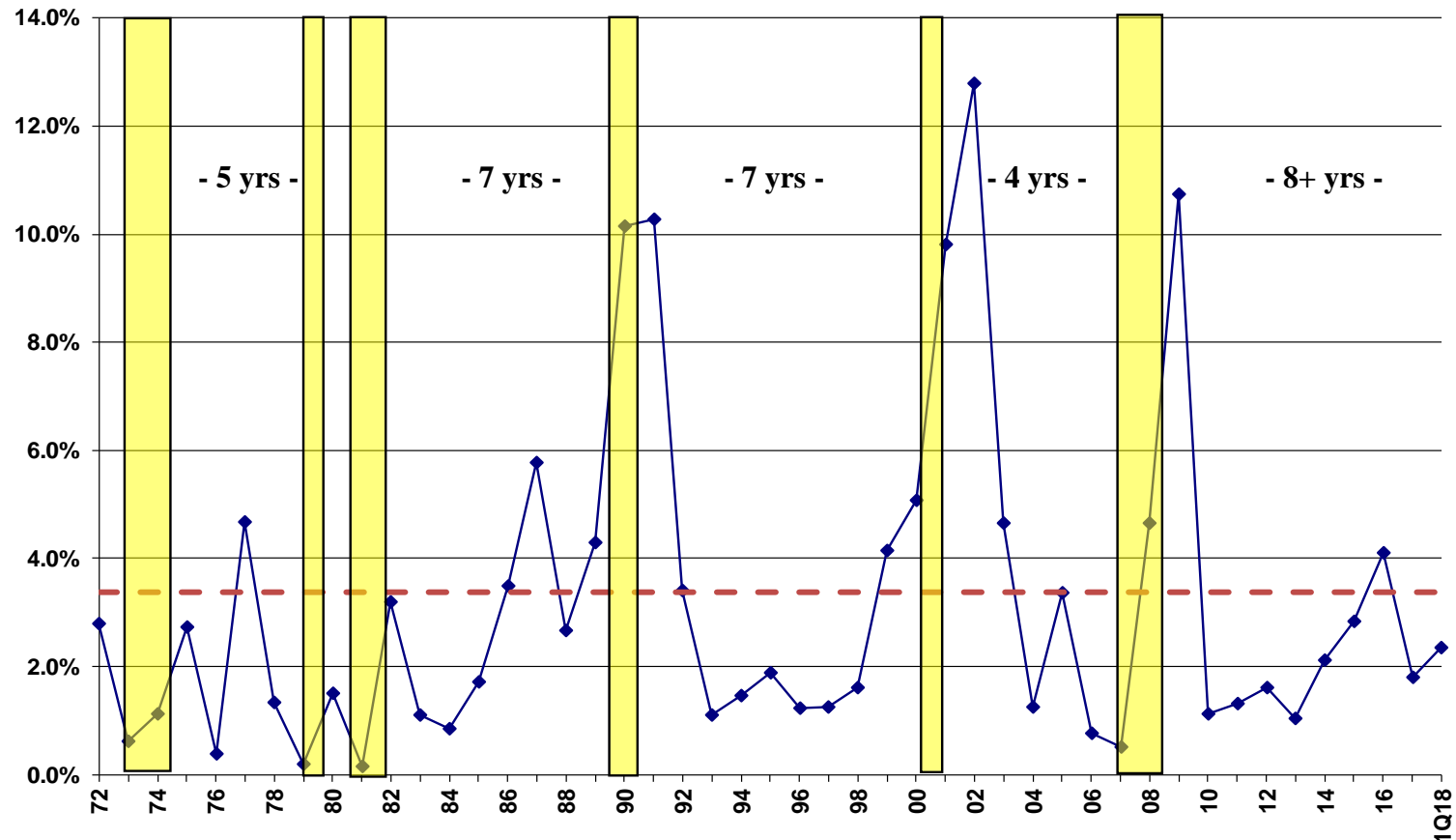
Quarterly Default Rate and Four-Quarter Moving Average  
 1989 – 2018 (5/7)



Source: Author's Compilations

# Historical Default Rates, Benign Credit Cycles and Recession Periods in the U.S.\*

## High-Yield Bond Market (1972 – 1Q18)



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 1Q2018, which is the LTM

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

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# **Forecasting Default Rates**

**Mortality Rate Approach (1989)**

**Yield-Spread vs. Default Rate Method (2008)**

**Distress Ratio vs. Default Rate Method (2008)**

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# Default and Recovery Forecasts: Summary of Forecast Models

<b>Model</b>	<b>2017 (12/31) Default Rate Forecast as of 12/31/2016</b>	<b>2018 (12/31) Default Rate Forecast as of 12/31/2017</b>	<b>2019 (5/22) Default Rate Forecast as of 5/22/2018</b>
Mortality Rate	4.20%	3.90%	3.90%
Yield-Spread	2.18% <sup>c</sup>	1.95% <sup>c</sup>	1.46% <sup>e</sup>
Distress Ratio	1.94% <sup>d</sup>	1.75% <sup>d</sup>	1.47% <sup>f</sup>
Average of Models Recovery Rates*	2.77% 43.8%	2.53% 45.1%	2.28% 46.3%

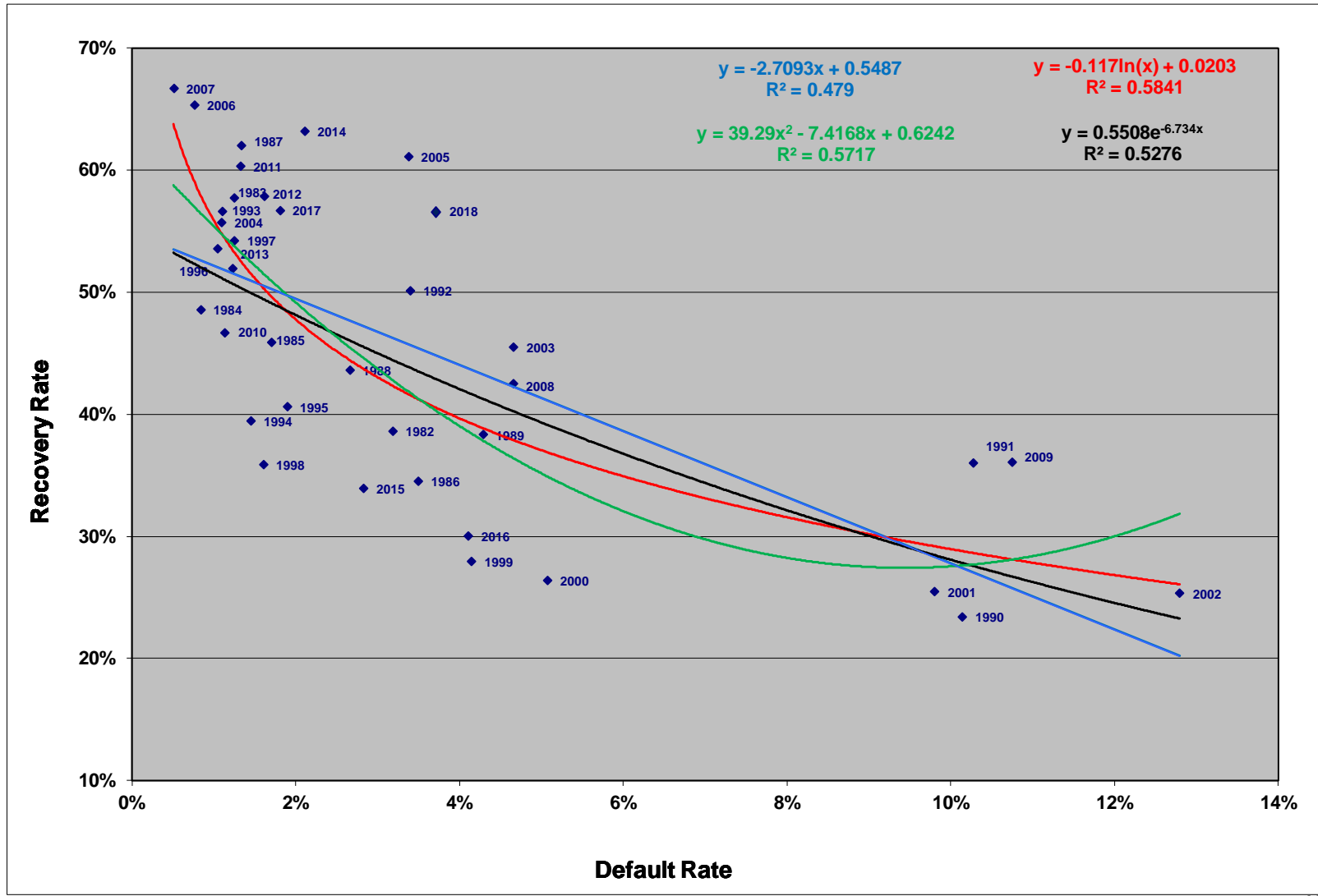
\* Recovery rate based on the log Linear equation between default and recovery rates, see Altman, et al (2005) Journal of Business, November and Slide 45. <sup>a</sup> Based on Dec. 31, 2016 yield-spread of 412.1bp. <sup>b</sup> Based on Dec. 31, 2016 Distress Ratio of 7.37%. <sup>c</sup> Based on Dec. 31, 2017 yield-spread of 394.6bp. <sup>d</sup> Based on Dec. 31, 2017 Distress Ratio of 6.11%. <sup>e</sup> Based on May 22, 2018 yield-spread of 356.9bp. <sup>f</sup> Based on Apr. 30, 2018 Distress Ratio of 4.11%.

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# Recovery Rates

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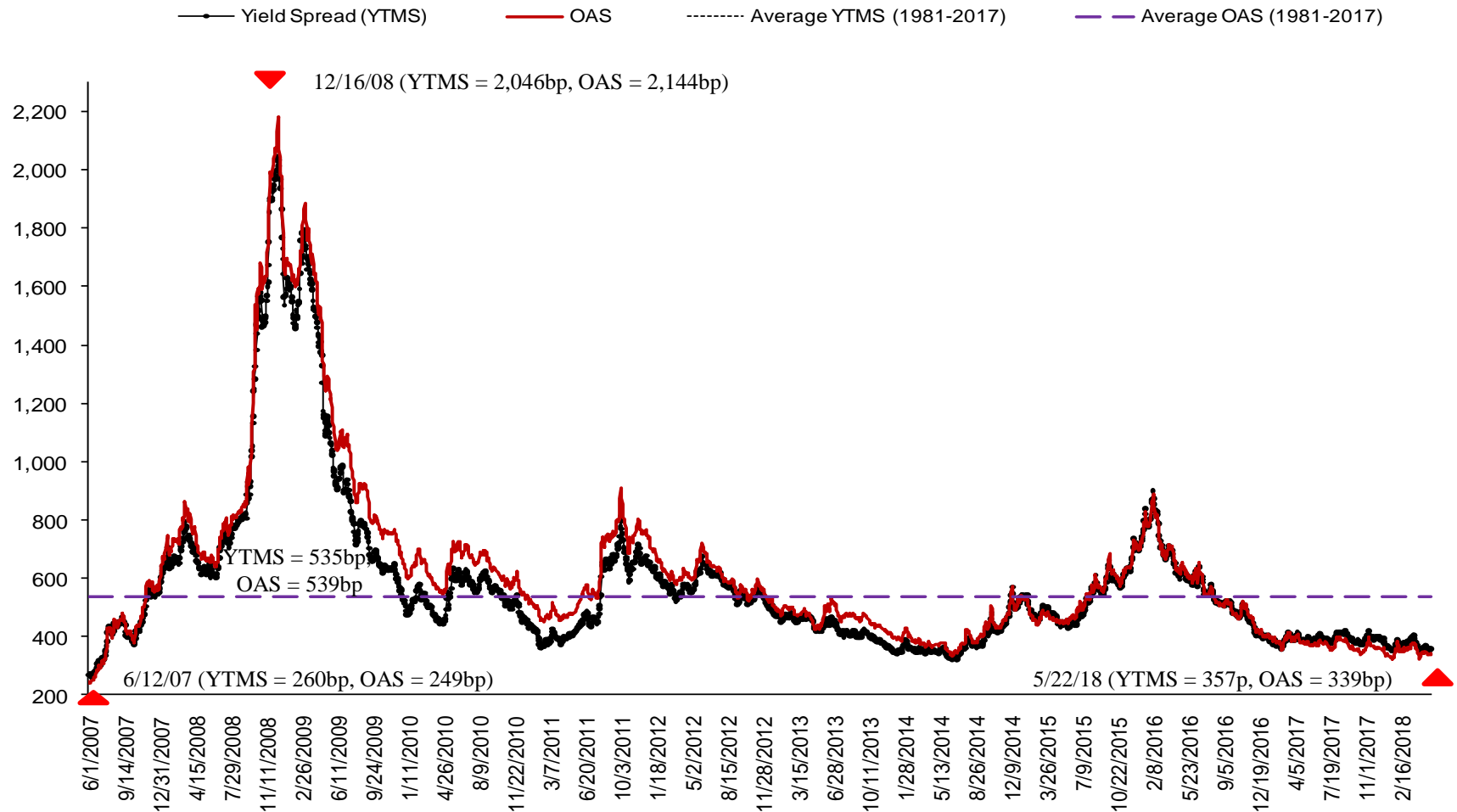
# Recovery Rate/Default Rate Association: Dollar-Weighted Average Recovery Rates to Dollar Weighted Average Default Rates, 1982 – 1Q18



Source: E. Altman, et. al., "The Link Between Default and Recovery Rates", NYU Salomon Center, S-03-4.

# YTM & Option-Adjusted Spreads Between High Yield Markets & U.S. Treasury Notes

June 01, 2007 – May 22, 2018



Sources: Citigroup Yieldbook Index Data and Bank of America Merrill Lynch.

# Annual Returns (1978 – 2018 (5/22))

## Yields and Spreads on 10-Year Treasury (Treas) and High Yield (HY) Bonds<sup>a</sup>

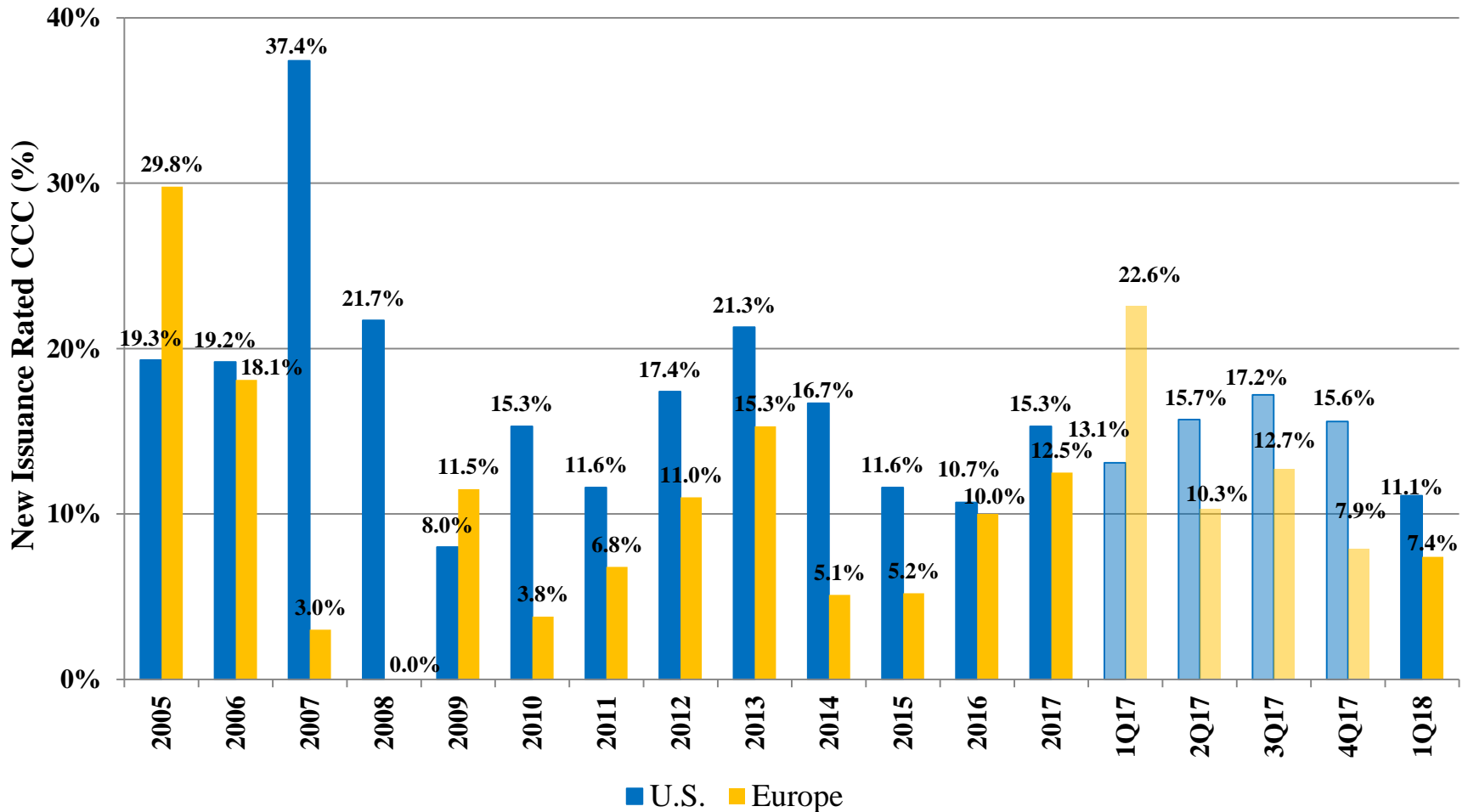
Year	Return (%)			Promised Yield (%)		
	HY	Treas	Spread	HY	Treas	Spread
2018 (5/22)	(0.03)	(4.70)	4.68	6.64	3.07	3.57
2017	7.05	2.13	4.92	6.35	2.41	3.95
2016	17.83	(0.14)	17.96	6.55	2.43	4.12
2015	(5.56)	0.90	(6.46)	9.27	2.27	7.00
2014	1.83	10.72	(8.89)	7.17	2.17	5.00
2013	7.22	(7.85)	15.06	6.45 <sup>b</sup>	3.01	3.45
2012	15.17	4.23	10.95	6.80	1.74 <sup>b</sup>	5.06
2011	5.52	16.99	(11.47)	8.41	1.88	6.54
2010	14.32	8.10	6.22	7.87	3.29	4.58
2009	55.19	(9.92)	65.11	8.97	3.84	5.14
2008	(25.91)	20.30	(46.21)	19.53	2.22	17.31
2007	1.83	9.77	(7.95)	9.69	4.03	5.66
2006	11.85	1.37	10.47	7.82	4.70	3.11
2005	2.08	2.04	0.04	8.44	4.39	4.05
2004	10.79	4.87	5.92	7.35	4.21	3.14
2003	30.62	1.25	29.37	8.00	4.26	3.74
2002	(1.53)	14.66	(16.19)	12.38	3.82	8.56
2001	5.44	4.01	1.43	12.31	5.04	7.27
2000	(5.68)	14.45	(20.13)	14.56	5.12	9.44
1999	1.73	(8.41)	10.14	11.41	6.44	4.97
1998	4.04	12.77	(8.73)	10.04	4.65	5.39
1997	14.27	11.16	3.11	9.20	5.75	3.45
1996	11.24	0.04	11.20	9.58	6.42	3.16
1995	22.40	23.58	(1.18)	9.76	5.58	4.18
1994	(2.55)	(8.29)	5.74	11.50	7.83	3.67
1993	18.33	12.08	6.25	9.08	5.80	3.28
1992	18.29	6.50	11.79	10.44	6.69	3.75
1991	43.23	17.18	26.05	12.56	6.70	5.86
1990	(8.46)	6.88	(15.34)	18.57	8.07	10.50
1989	1.98	16.72	(14.74)	15.17	7.93	7.24
1988	15.25	6.34	8.91	13.70	9.15	4.55
1987	4.57	(2.67)	7.24	13.89	8.83	5.06
1986	16.50	24.08	(7.58)	12.67	7.21	5.46
1985	26.08	31.54	(5.46)	13.50	8.99	4.51
1984	8.50	14.82	(6.32)	14.97	11.87	3.10
1983	21.80	2.23	19.57	15.74	10.70	5.04
1982	32.45	42.08	(9.63)	17.84	13.86	3.98
1981	7.56	0.48	7.08	15.97	12.08	3.89
1980	(1.00)	(2.96)	1.96	13.46	10.23	3.23
1979	3.69	(0.86)	4.55	12.07	9.13	2.94
1978	7.57	(1.11)	8.68	10.92	8.11	2.81
Arithmetic Annual Average						
1978-2017	10.39	7.55	2.84	11.25	6.07	5.18
Compound Annual Average						
1978-2017	9.51	7.02	2.49			

<sup>a</sup> End-of-year yields. <sup>b</sup> Lowest yield in time series. Source: Citigroup's High Yield Composite Index



# U.S. & European High-Yield Bond Market: CCC Rated New Issuance (%)

2005 – 1Q18



Source: Bank of America Merrill Lynch

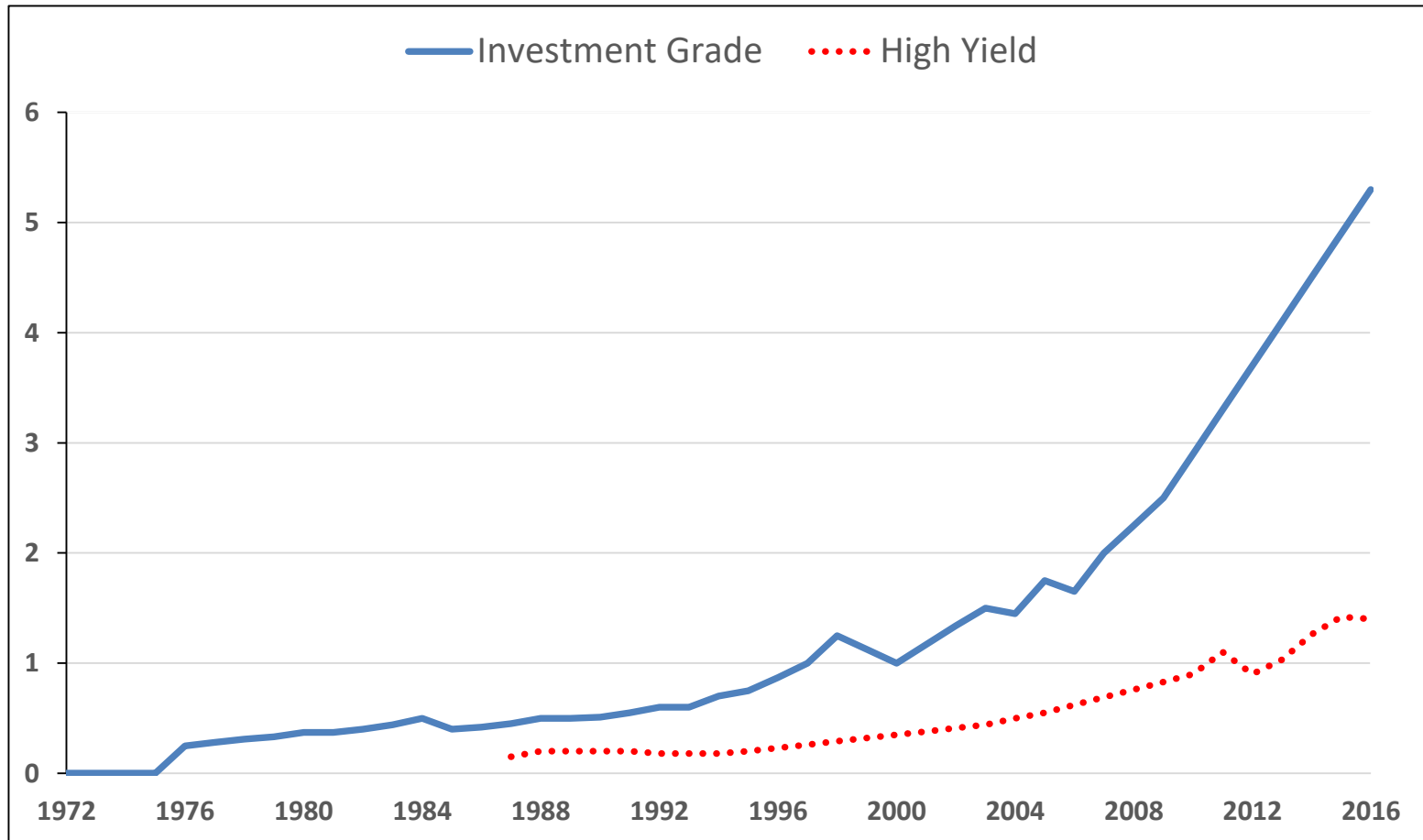
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# **Some Concerns About the Benign Credit Cycle**

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# U.S. Corporate Leverage Surges

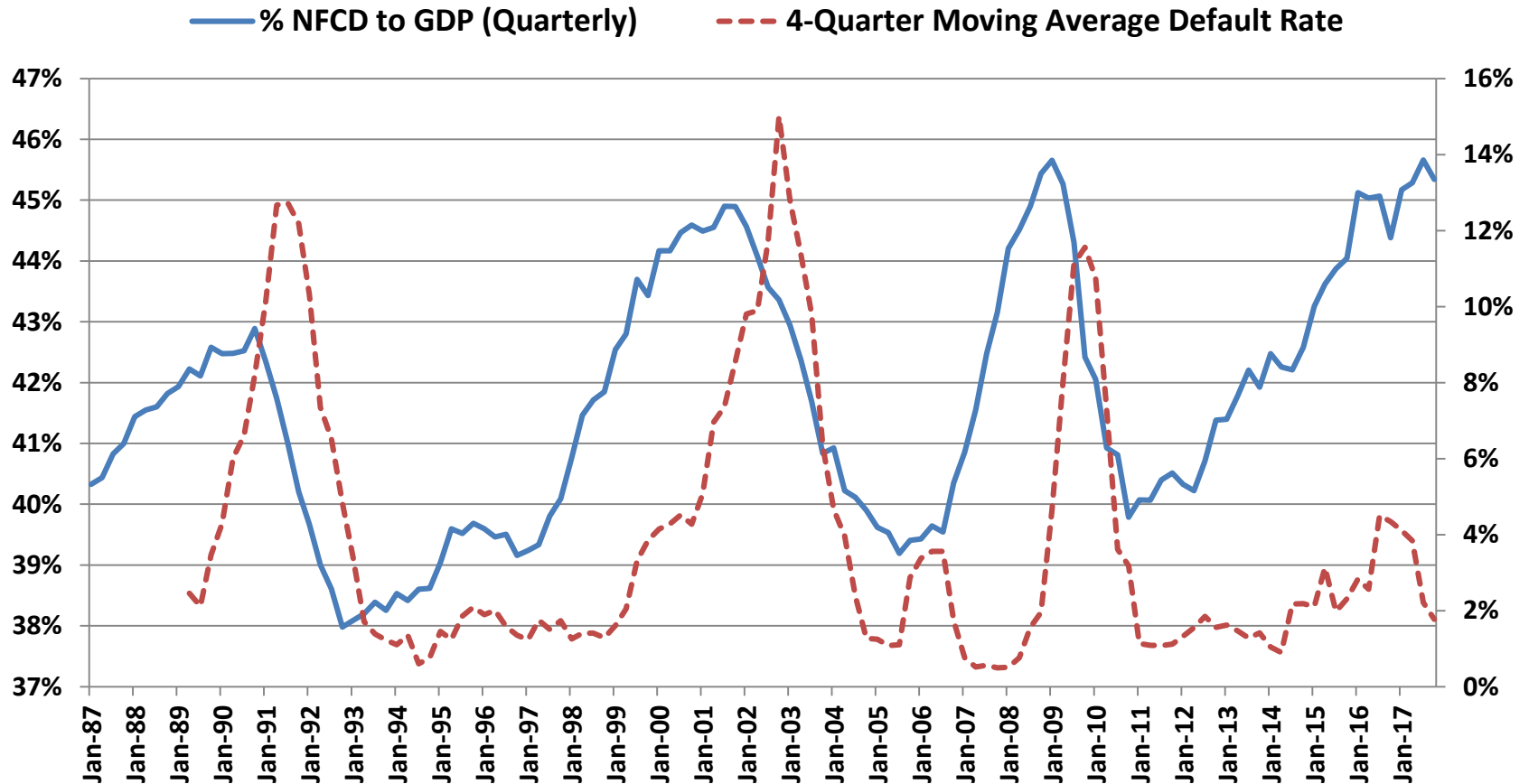
Outstanding Corporate Bonds, by Rating (\$tn)



Sources: Bank of America Merrill Lynch, Estimated from Platt, E., "Triple A Quality Fades as Companies Embrace Debt", *Financial Times*, May 24, 2016.

# U.S. Non-financial Corporate Debt (Credit Market Instruments) to GDP: Comparison to 4-Quarter Moving Average Default Rate

January 1, 1987 – September 30, 2017

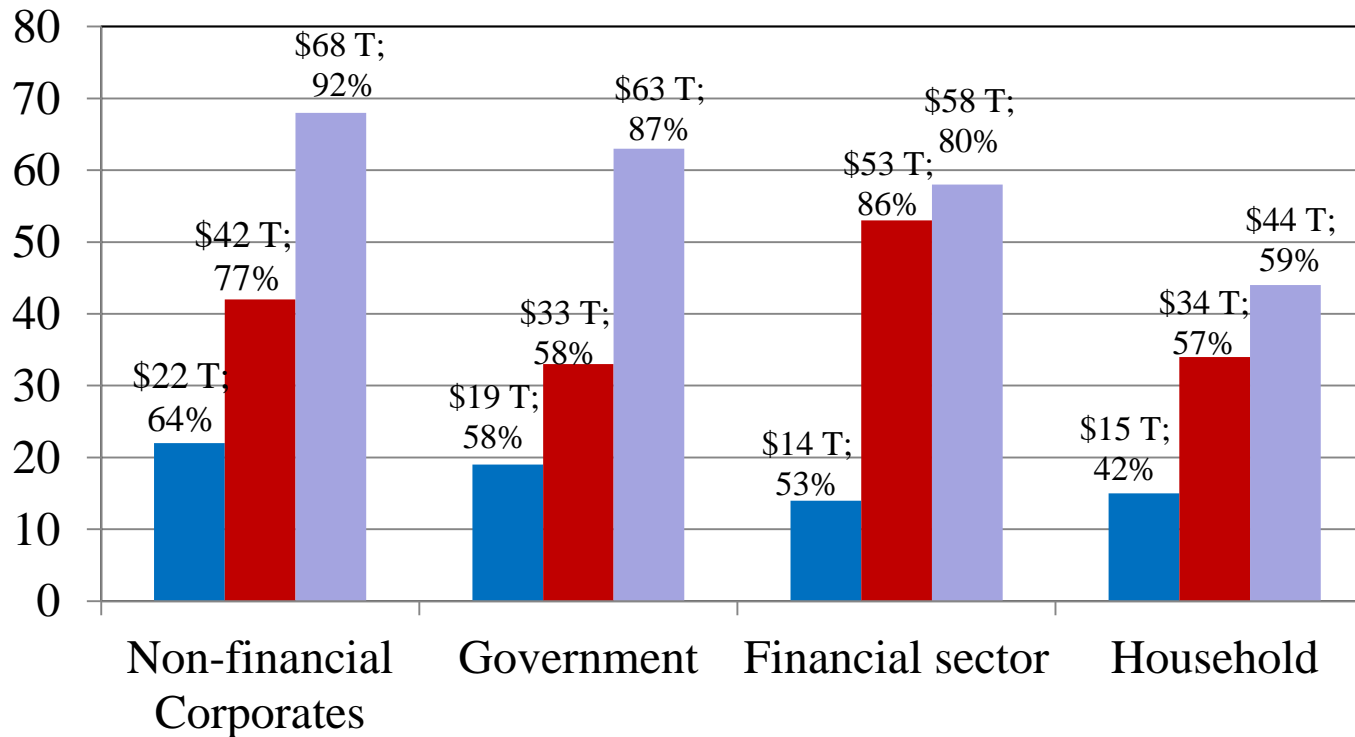


Sources: FRED, Federal Reserve Bank of St. Louis and Altman/Kuehne High-Yield Default Rate data.

# Global Sectoral Indebtedness

\$ Trillion; % GDP; end of each Q3

■ 1997 ■ 2007 ■ 2017



Year	% of GDP	Total \$ Amt. (\$ T)
1997	217%	70
2007	278%	162
2017	318%	233

Sources: Chart from *Independent UK* using IIF, BIS, IMF and Haver data.

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# **Comparative Health of High-Yield Firms (2007 vs. 2016)**

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# Z-Score Component Definitions and Weightings

<u>Variable</u>	<u>Definition</u>	<u>Weighting Factor</u>
$X_1$ - - - - -	$\frac{\text{Working Capital}}{\text{Total Assets}}$	1.2
$X_2$ - - - - -	$\frac{\text{Retained Earnings}}{\text{Total Assets}}$	1.4
$X_3$ - - - - -	$\frac{\text{EBIT}}{\text{Total Assets}}$	3.3
$X_4$ - - - - -	$\frac{\text{Market Value of Equity}}{\text{Book Value of Total Liabilities}}$	0.6
$X_5$ - - - - -	$\frac{\text{Sales}}{\text{Total Assets}}$	1.0

# Median Z-Score by S&P Bond Rating for U.S. Manufacturing Firms: 1992 - 2017

<b>Rating</b>	<b>2017 (No.)</b>	<b>2013 (No.)</b>	<b>2004-2010</b>	<b>1996-2001</b>	<b>1992-1995</b>
<b>AAA/AA</b>	<b>4.20 (14)</b>	<b>4.13 (15)</b>	<b>4.18</b>	<b>6.20*</b>	<b>4.80*</b>
<b>A</b>	<b>3.85 (55)</b>	<b>4.00 (64)</b>	<b>3.71</b>	<b>4.22</b>	<b>3.87</b>
<b>BBB</b>	<b>3.10 (137)</b>	<b>3.01 (131)</b>	<b>3.26</b>	<b>3.74</b>	<b>2.75</b>
<b>BB</b>	<b>2.45 (173)</b>	<b>2.69 (119)</b>	<b>2.48</b>	<b>2.81</b>	<b>2.25</b>
<b>B</b>	<b>1.65 (94)</b>	<b>1.66 (80)</b>	<b>1.74</b>	<b>1.80</b>	<b>1.87</b>
<b>CCC/CC</b>	<b>0.73 (4)</b>	<b>0.23 (3)</b>	<b>0.46</b>	<b>0.33</b>	<b>0.40</b>
<b>D</b>	<b>-0.10 (6)<sup>1</sup></b>	<b>0.01 (33)<sup>2</sup></b>	<b>-0.04</b>	<b>-0.20</b>	<b>0.05</b>

\*AAA Only.

<sup>1</sup> From 1/2014-11/2017, <sup>2</sup>From 1/2011-12/2013.

Sources: S&P Global Market Intelligence's *Compustat* Database, mainly S&P 500 firms, compilation by NYU Salomon Center, Stern School of Business.



# Z" Score Model for Manufacturers, Non-Manufacturer Industrials; Developed and Emerging Market Credits (1995)

$$Z'' = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

$$X_1 = \frac{\text{Current Assets} - \text{Current Liabilities}}{\text{Total Assets}}$$

$$X_2 = \frac{\text{Retained Earnings}}{\text{Total Assets}}$$

$$X_3 = \frac{\text{Earnings Before Interest and Taxes}}{\text{Total Assets}}$$

$$X_4 = \frac{\text{Book Value of Equity}}{\text{Total Liabilities}}$$

# US Bond Rating Equivalents Based on Z"-Score Model

$$Z'' = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

Rating	Median 1996 Z''-Score <sup>a</sup>	Median 2006 Z''-Score <sup>a</sup>	Median 2013 Z''-Score <sup>a</sup>
AAA/AA+	8.15 (8)	7.51 (14)	8.80 (15)
AA/AA-	7.16 (33)	7.78 (20)	8.40 (17)
A+	6.85 (24)	7.76 (26)	8.22 (23)
A	6.65 (42)	7.53 (61)	6.94 (48)
A-	6.40 (38)	7.10 (65)	6.12 (52)
BBB+	6.25 (38)	6.47 (74)	5.80 (70)
BBB	5.85 (59)	6.41 (99)	5.75 (127)
BBB-	5.65 (52)	6.36 (76)	5.70 (96)
BB+	5.25 (34)	6.25 (68)	5.65 (71)
BB	4.95 (25)	6.17 (114)	5.52 (100)
BB-	4.75 (65)	5.65 (173)	5.07 (121)
B+	4.50 (78)	5.05 (164)	4.81 (93)
B	4.15 (115)	4.29 (139)	4.03 (100)
B-	3.75 (95)	3.68 (62)	3.74 (37)
CCC+	3.20 (23)	2.98 (16)	2.84 (13)
CCC	2.50 (10)	2.20 (8)	2.57(3)
CCC-	1.75 (6)	1.62 (-) <sup>b</sup>	1.72 (-) <sup>b</sup>
CC/D	0 (14)	0.84 (120)	0.05 (94) <sup>c</sup>

<sup>a</sup>Sample Size in Parantheses. <sup>b</sup>Interpolated between CCC and CC/D. <sup>c</sup>Based on 94 Chapter 11 bankruptcy filings, 2010-2013.  
Sources: Compustat, Company Filings and S&P.

# Comparing Financial Strength of High-Yield Bond Issuers in 2007 & 2012/2014/2017

Number of Firms		
	Z-Score	Z''-Score
2007	294	378
2012	396	486
2014	577	741
2017	529	583

Year	Average Z-Score/ (BRE)*	Median Z-Score/ (BRE)*	Average Z''-Score/ (BRE)*	Median Z''-Score/ (BRE)*
2007	1.95 (B+)	1.84 (B+)	4.68 (B+)	4.82 (B+)
2012	1.76 (B)	1.73 (B)	4.54 (B)	4.63 (B)
2014	2.03 (B+)	1.85 (B+)	4.66 (B+)	4.74 (B+)
2017	2.08 (B+)	1.98 (B+)	5.08 (BB-)	5.09 (BB-)

\*Bond Rating Equivalent

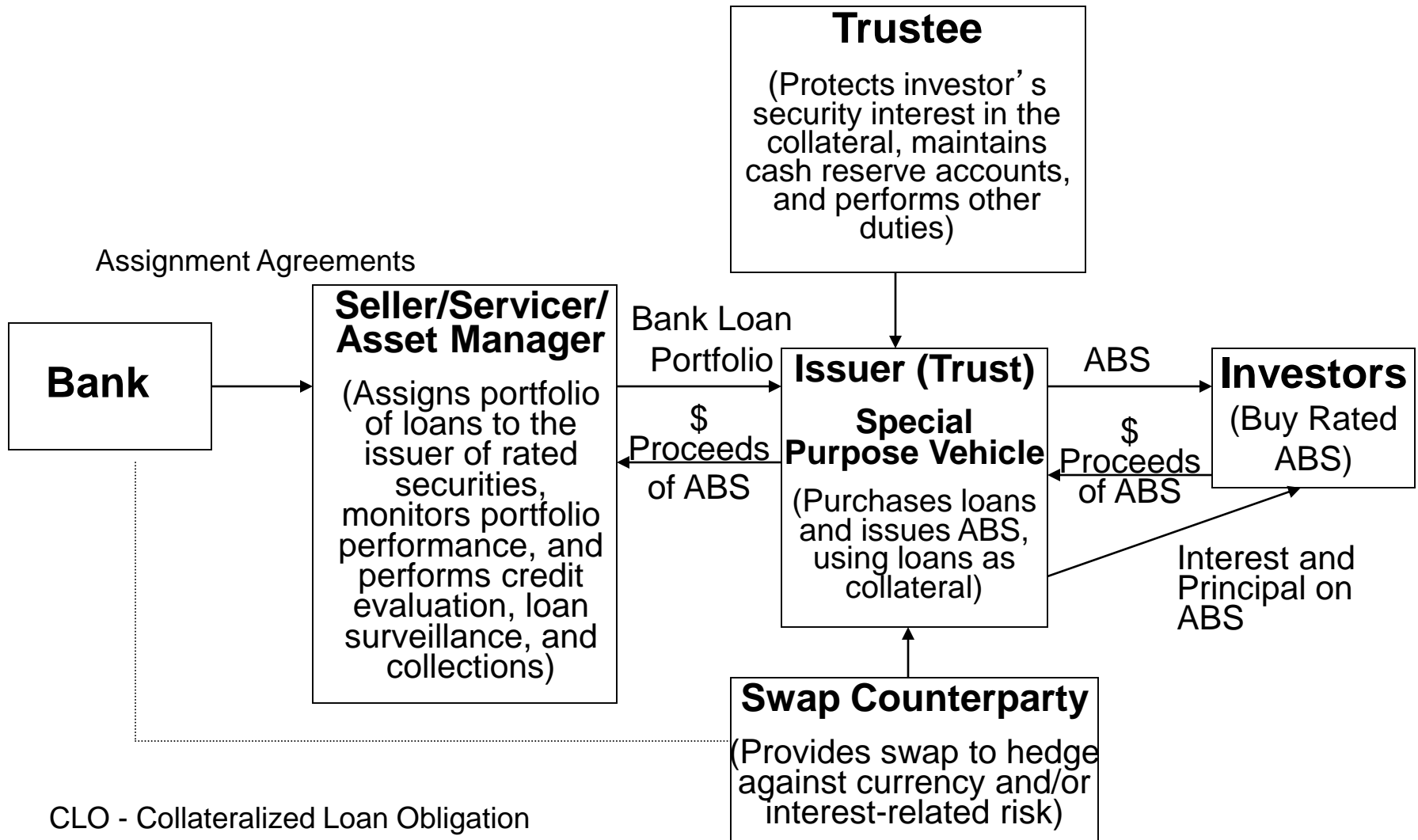
Source: Authors' calculations, data from Altman and Hotchkiss (2006) and S&P Global Market Intelligence's S&P *Capital 27 IQ platform/Compustat database*.

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# Sample CLO Transaction Structure

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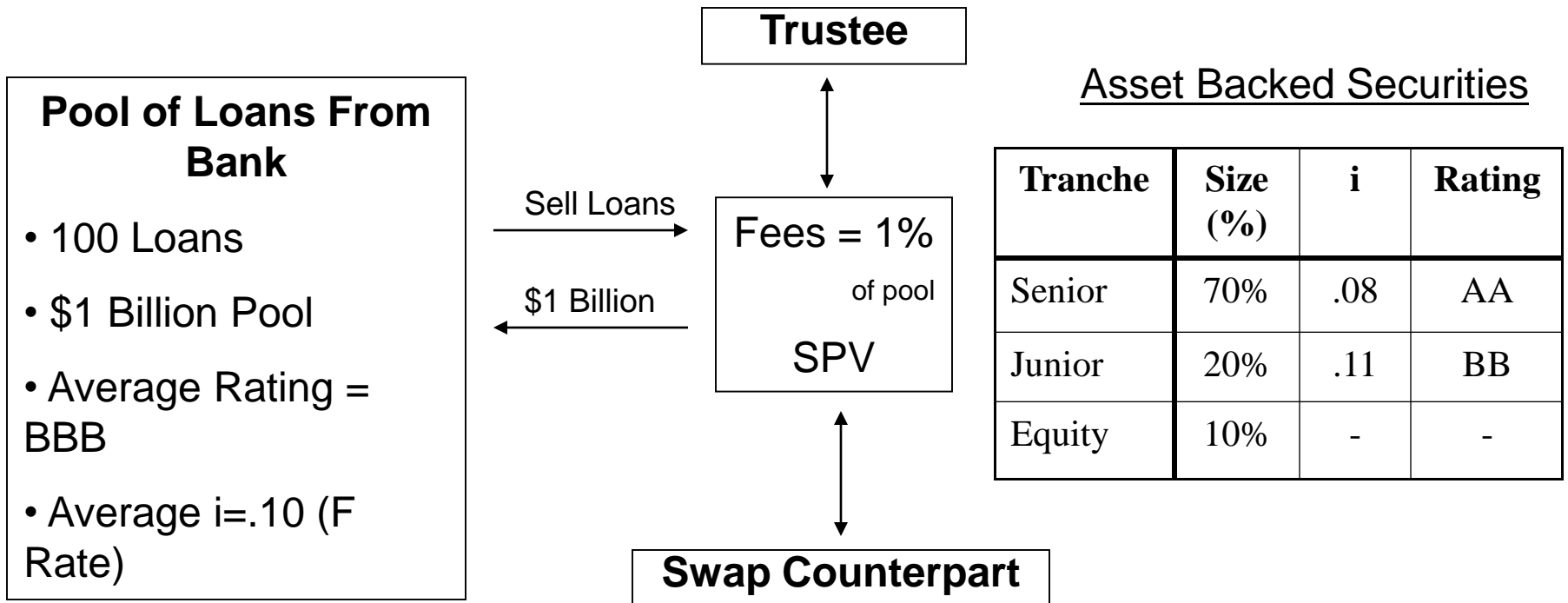
# Sample CLO Transaction Structure



CLO - Collateralized Loan Obligation

ABS - Asset-backed Securities

# CLO Example



# CLO Example

## Returns with No Defaults: Returns to ABS

		<u>First Year</u>	<u>Second Year</u>
Total Interest	=	\$100 million	\$100 million
Interest to Senior	=	\$56 million	\$56 million
Fees	=	\$10 million	-----
Net From Jr.		\$34 million	\$44 million
Interest to Jr.	=	\$22 million	\$22 million
Net to Equity	=	\$12 million	\$22 million
ROE	=	???	???

# Major Risks Going Forward

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- Global Economic Performance – Primarily U.S., China and Europe: Impact on Default Rates, Credit Availability and Quality (No Current Major Concern)
- Falling Oil Prices (No Current Major Concern)
- Global Debt Excess and Increasing Interest Rates
- High-Yield Fundamentals Still Fairly Weak
- Contagion Between Markets – Risky Debt and Equity
- Interest Rates and Inflation – Reduced Importance of the Search-for-Yield
- LBO, Covenant-Lite and CCC New Issuance
- Sovereign Debt Crisis – Asia (1997), Europe (2009-13), Emerging Markets?
- Uncertainties (non-quantifiable) – e.g. Political, Trade, Other



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# **A Novel Approach to Assessing Sovereign Debt Default Risk**

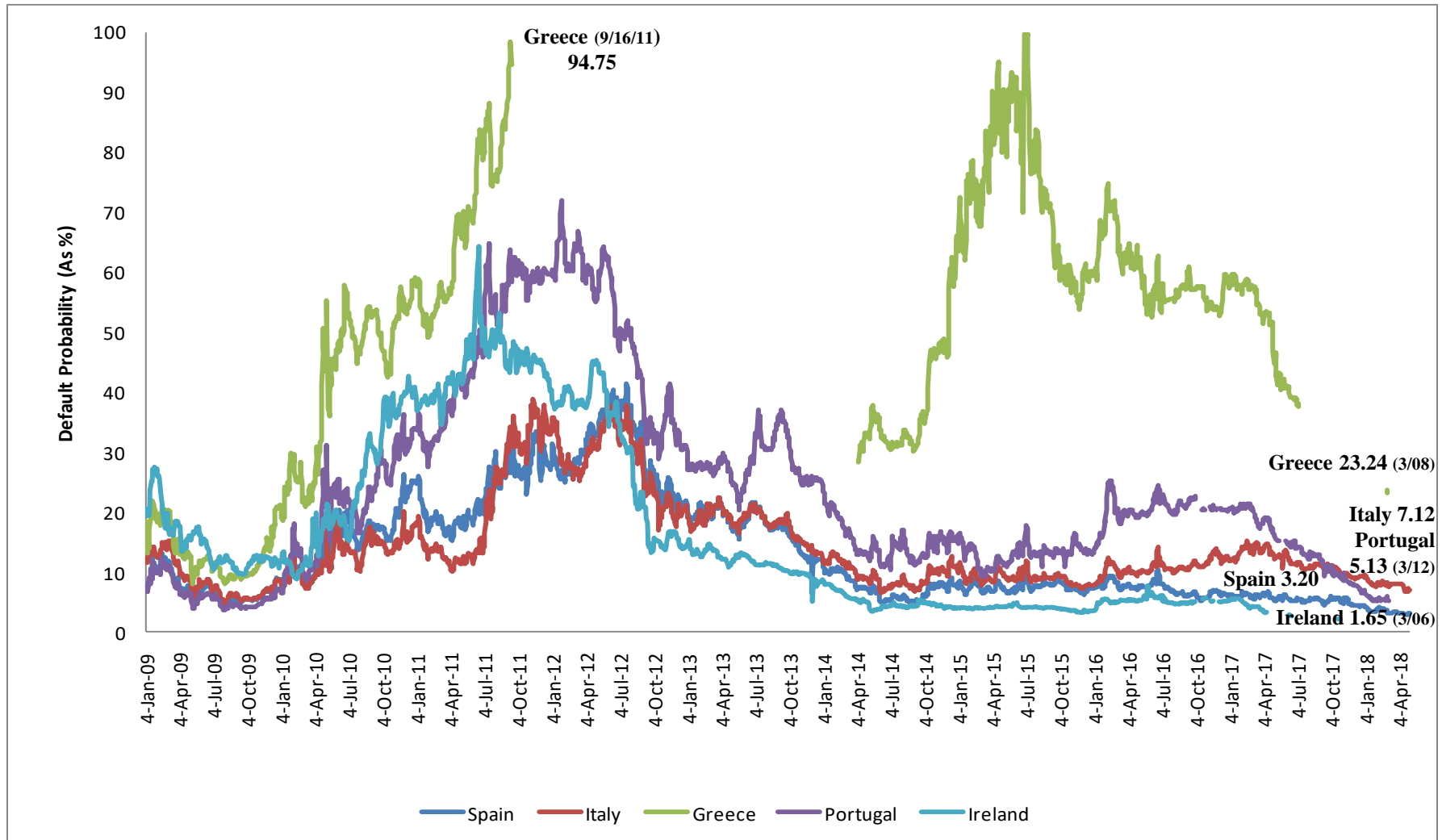
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# Measuring and Assessing Sovereign Default Risk

- Traditional and Market Indicators of Risk of Default (PDs)
  - Macroeconomic Related Variables
  - Credit Default Swaps (CDS) and their Implied Probability of Default (PDs)
- Traditional Default Prediction Models
  - Statistical and Aggregative Techniques for Individual Firm PDs
- A Novel Approach to Assessing Sovereign Debt Default Risk
  - To Assess the Default Risk of a Sovereign Based on the Health of the Private Sector, Particularly the Non-Financial and Financial Corporate Debt Sectors
  - Using a Default Prediction Model (Z-Metrics Model, 2010), We Aggregate the Corporate Default Probabilities and Compare Them Over Time and Across Countries
  - Results are Compared with the Implied Probability of Default from CDS Spreads

# Five Year Implied Probabilities of Default (PD) From Capital Market CDS Spreads\*

Jan. 2009 – May 07, 2018



\* Assuming a 40% recovery rate (R); based on the median CDS spread (s). PD Computed as  $1 - e^{(-5*s/(1-R))}$ .

Source: Bloomberg

# European & Latin American Government Benchmark Yields and Spreads

May 07, 2018

Country	5-Year Price	5-Year Yield %	5-Year Spread to Germany	10-Year Price	10-Year Yield %	10-Year Spread to Germany/ U.S.
<b>Germany</b>	100.38	-0.08	n/a	99.42	0.56	n/a
Sweden	107.88	0.06	0.14	100.71	0.67	0.11
Greece	101.597	3.06	3.14	96.94	4.10	3.54
Ireland	99.79	0.03	0.11	99.48	0.94	0.38
Italy	101.57	0.61	0.69	102.21	1.76*	1.20
Portugal	123.55	0.54	0.62	104.29	1.66	1.10
Spain	101.19	0.17	0.25	101.15	1.27*	0.71
Argentina	101.02	6.40	3.61	88.75	7.49	4.54
Brazil	93.33	4.19	1.41	95.07	5.26	2.31
Colombia	102.23	3.58	0.79	95.93	4.41	1.46
Mexico	96.33	7.53	4.75	93.62	4.56	1.60

\*10-Year Yield as of July 16, 2012 was 6.10% for Italy and 6.77% for Spain.

Source: Bloomberg

# Financial Health of the Corporate, Non-Financial Sector: Selected European Countries and Australia/U.S.A. in 2009-2017

Z-Metrics PD Estimates* : Five-Year Public Model										
Country	Listed Companies (2017)**	75th Percentile PD (25% of Firms w/PDs ≥ Percentages Below)								
		2017	2016	2015	2014	2013	2012	2011	2010	2009
Ireland	26	2.3%	2.6%	2.5%	2.9%	2.7%	4.5%	5.9%	7.2%	10.8%
Sweden	209	3.9%	3.9%	4.7%	5.8%	5.7%	6.1%	8.2%	6.5%	7.0%
Netherlands	78	4.0%	6.6%	8.7%	9.6%	6.2%	6.3%	10.0%	6.9%	6.9%
U.K.	501	4.7%	5.2%	5.0%	5.8%	4.7%	5.5%	8.7%	6.0%	9.2%
Germany	315	5.4%	6.9%	8.2%	9.7%	8.4%	8.7%	11.0%	8.8%	11.7%
France	322	6.8%	7.9%	8.8%	9.0%	7.8%	9.9%	13.0%	8.4%	10.9%
Spain	90	9.5%	11.2%	13.9%	14.2%	14.6%	16.3%	18.0%	11.9%	11.0%
Italy	171	9.9%	11.5%	13.9%	14.8%	15.2%	19.3%	21.6%	15.1%	18.0%
Poland	189	10.9%	10.5%	10.8%	11.9%	9.4%	13.8%	20.8%	9.4%	12.4%
Portugal	35	20.0%	30.0%	31.3%	24.3%	21.9%	31.9%	32.1%	22.6%	20.6%
Greece	74	20.8%	26.8%	36.0%	42.3%	32.0%	38.4%	51.1%	37.0%	27.3%
U.S.A.	2,450	2.9%	3.2%	3.5%	3.6%	3.7%	4.6%	11.7%	8.0%	11.5%

\*Since the Z-Metrics Model is not practically available for most analysts, we could substitute the Z"-Score method (available from <altmanZscoreplus.com>).

\*\*Sales > € 50mm

Sources: RiskMetrics Group (MSCI), Markit, Compustat Global.

# Financial Health of the Corporate, Non-Financial Sector: Selected Asian, LatAm & BRIC Countries

Z-Metrics PD Estimates* : Five-Year Public Model								
Country	Listed Companies (2017)**	75th Percentile PD (25% of Firms w/PDs ≥ Percentages Below)						
		2017	2016	2015	2014	2013	2012	Late 1990' s
Mexico	88	5.9%	6.2%	6.3%	6.0%	5.7%	6.0%	n/a
Chile	93	6.8%	9.5%	9.5%	9.8%	8.0%	6.3%	n/a
Argentina	43	8.1%	11.0%	14.1%	19.1%	21.9%	17.5%	n/a
Brazil	185	15.7%	22.9%	27.8%	20.6%	14.9%	15.1%	7.6%
Japan	2,495	4.0%	4.8%	5.4%	6.1%	5.8%	7.0%	5.8%
China	2,694	5.4%	5.7%	7.3%	8.1%	7.7%	8.5%	10.6%
Hong Kong	120	6.9%	7.0%	8.2%	8.6%	7.5%	11.6%	8.5%
India	1,024	9.9%	13.6%	14.7%	17.4%	19.7%	15.3%	20.3%
S. Korea	1,095	10.2%	11.6%	12.0%	14.1%	14.2%	14.6%	29.0%
Singapore	262	10.9%	13.6%	14.6%	11.8%	9.2%	9.1%	7.7%
Indonesia	239	11.5%	13.9%	17.0%	12.4%	14.6%	10.7%	18.5%
Russia	146	14.8%	15.9%	22.6%	25.6%	11.8%	9.3%	26.6%

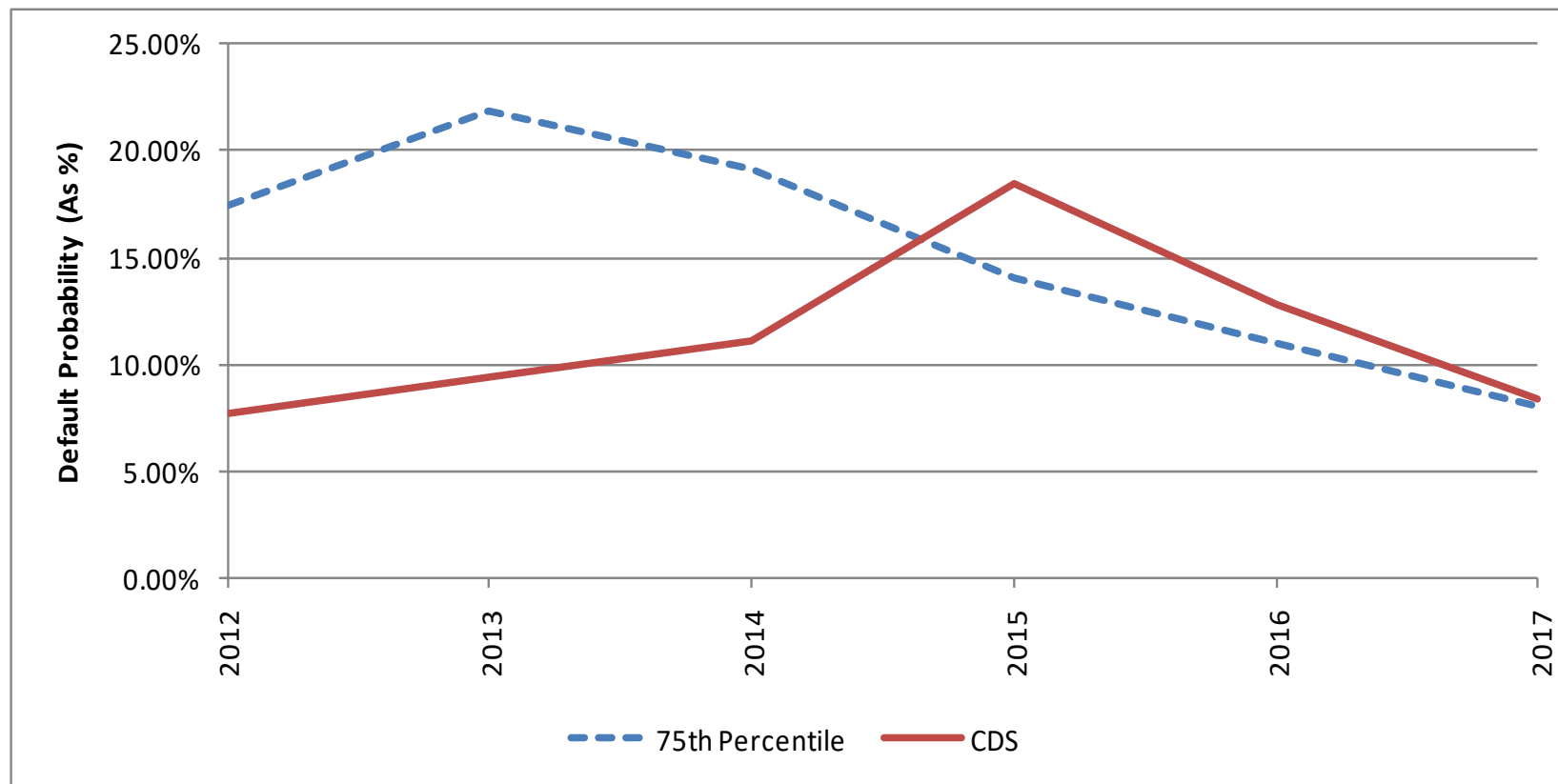
\*Since the Z-Metrics Model is not practically available for most analysts, we could substitute the Z'-Score method (available from <altmanZscoreplus.com>).

\*\*Sales > \$ 50mm

Sources: RiskMetrics Group (MSCI), Markit, Compustat Global.

# Five Year Implied Probabilities of Default (PD) From Sovereign CDS\* Spreads vs 75<sup>th</sup> Percentile Corporate PD

## Argentina, 2012 – 2017

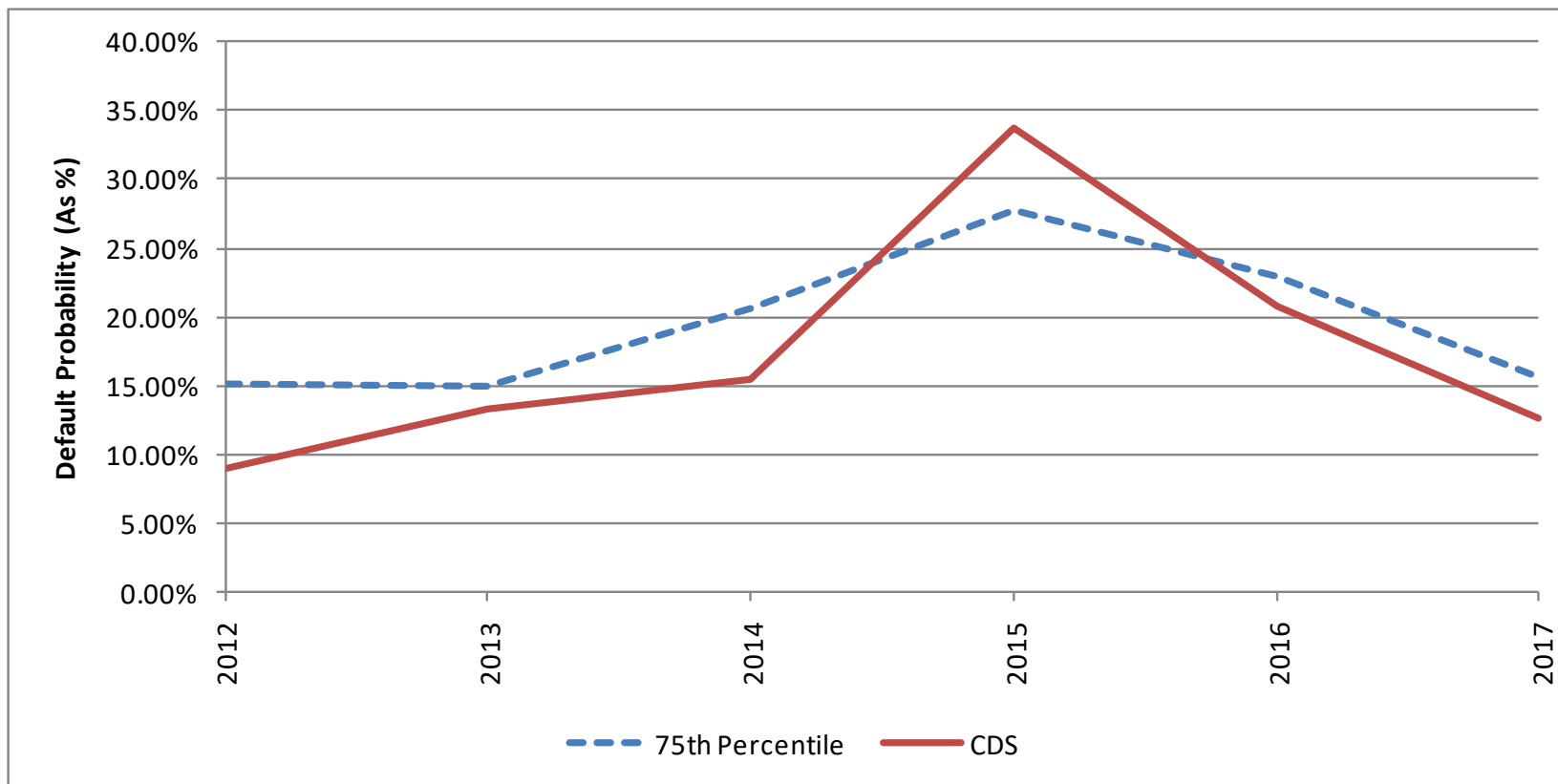


\* Assuming a 40% recovery rate (R); based on the median CDS spread (s). PD Computed as  $1 - e^{(-5*s/(1-R))}$ .

Source: Bloomberg

# Five Year Implied Probabilities of Default (PD) From Sovereign CDS\* Spreads vs 75<sup>th</sup> Percentile Corporate PD

## Brazil, 2012 – 2017



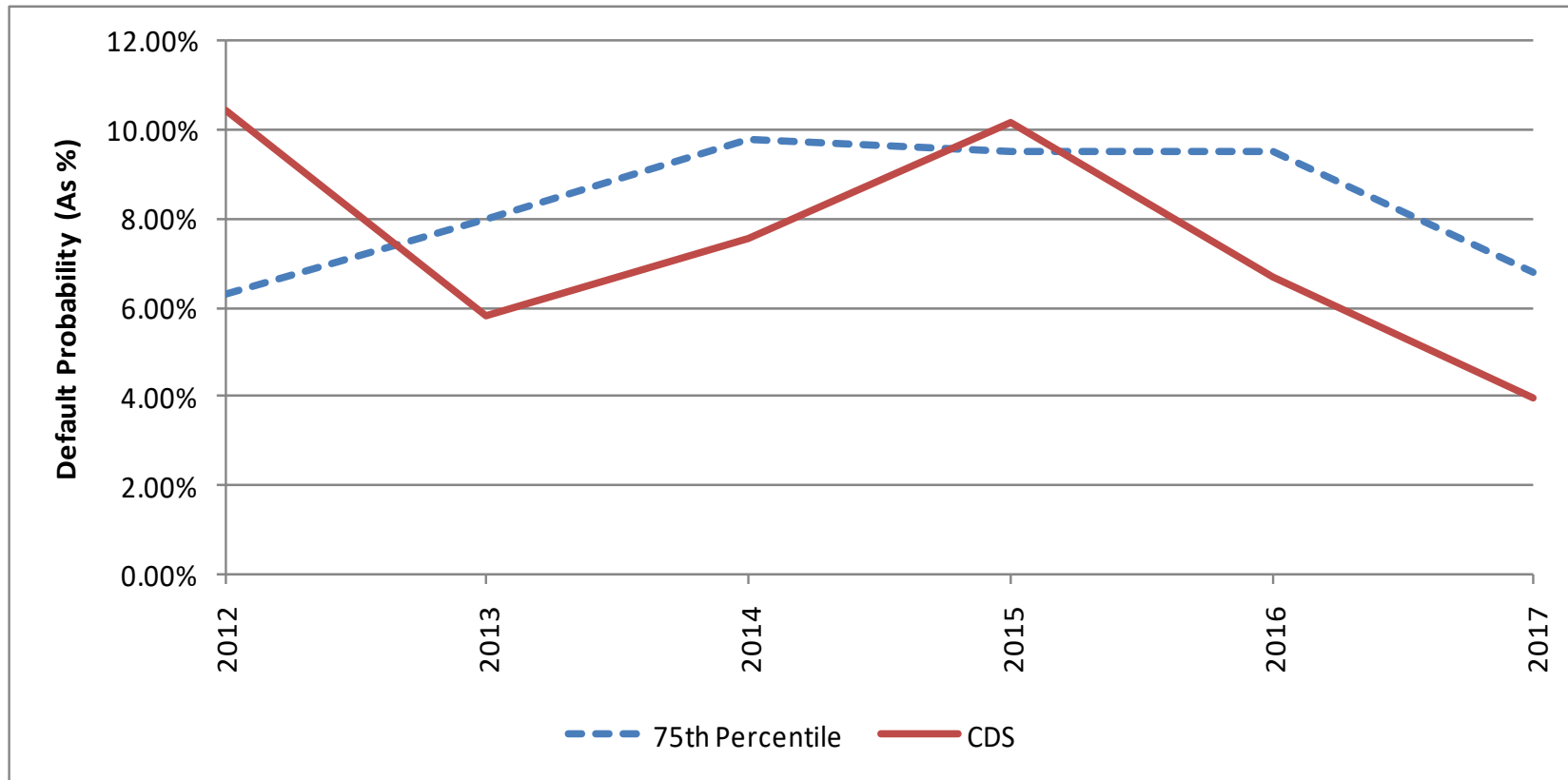
\* Assuming a 40% recovery rate (R); based on the median CDS spread (s). PD Computed as  $1 - e^{(-5*s/(1-R))}$ .

Source: Bloomberg



# Five Year Implied Probabilities of Default (PD) From Sovereign CDS\* Spreads vs 75<sup>th</sup> Percentile Corporate PD

Chile, 2012 – 2017

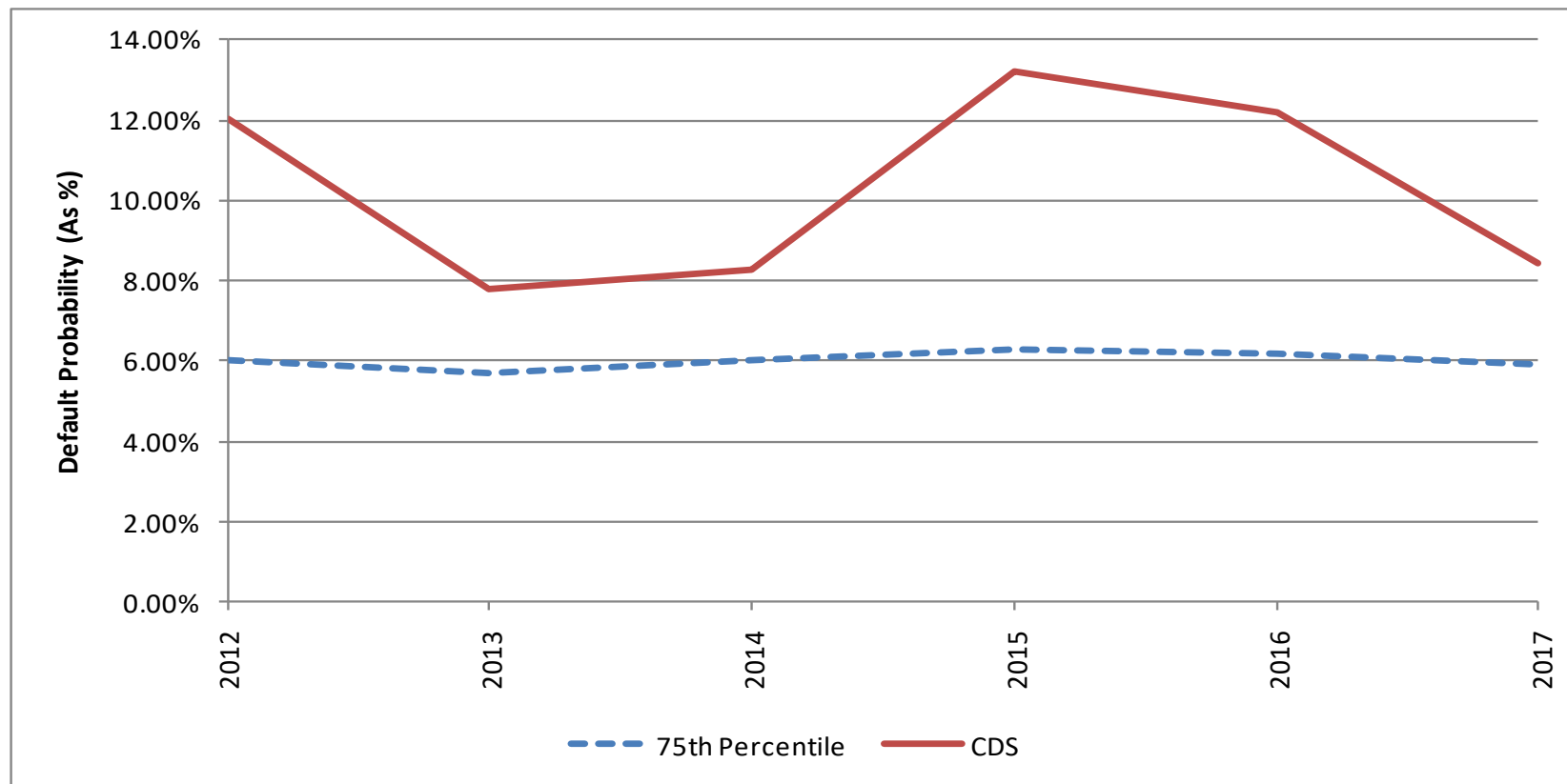


\* Assuming a 40% recovery rate (R); based on the median CDS spread (s). PD Computed as  $1 - e^{(-5*s/(1-R))}$ .

Source: Bloomberg

# Five Year Implied Probabilities of Default (PD) From Sovereign CDS\* Spreads vs 75<sup>th</sup> Percentile Corporate PD

Mexico, 2012 – 2017



\* Assuming a 40% recovery rate (R); based on the median CDS spread (s). PD Computed as  $1 - e^{(-5*s/(1-R))}$ .

Source: Bloomberg