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# The Link Between Default and Recovery Rates

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# Outline

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- Default and recovery rates: previous research
- An empirical test of DR/RR correlation
- Some recent empirical evidence
- Two simulation exercises:
  - how the DR/RR correlation affects
    - Credit risk models
    - Procyclicality issues

# Previous research works/1: credit pricing models

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	<i>Main contributions</i>	<i>RR is treated as:</i>	<i>Relationship between PD and RR</i>
<b>1<sup>st</sup> generation structural form models</b>	Merton '74, Black-Cox '76, Geske '77, Vasicek '84, Crouhy-Galai '94, Mason Rosenfeld '84	<b>Endogenous:</b> depends on structural characteristics of the defaulted firm	<b>PD and RR are inversely related</b>
<b>2<sup>nd</sup> generation structural form models</b>	Kim et al. '93, Nielsen et al., Santa Clara '93, Hull-White '95, Longstaff-Schwarz '95	<b>Exogenous and independent of the firm's asset value</b>	<b>PD and RR are independent</b>
<b>Reduced form models</b>	Litterman-Iben '91, Madan-Unal '95, JT '95, JLT '97, Duffie-Singleton '99	<b>Exogenous (constant or stochastic)</b>	<b>PD and RR are independent</b>

# Previous research works/2: credit VaR models and beyond

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	<i>Main contributions</i>	<i>RR is treated as:</i>	<i>Relationship between PD and RR</i>
<b>Credit VaR models</b>	<b>Gupton et al. '97, Wilson '97, CSFP '97, McQuown '97, Crosbie '99</b>	<b>Constant (CSFP) or stochastic</b>	<b>PD and RR are independent</b>
<b>Some latest contributions</b>	<b>Frye '00 and '01, Jarrow '01, Carey-Gordy '01, Altman-Brady '01, Jokivouille-Peura '01, Hu and Perraudin, '02</b>	<b>Stochastic, depending on some macro or supply factor</b>	<b>PD and RR are correlated, usually in a negative way</b>

# Premiums Research Works/3: Recent Empirical Results and Tests

## Main Contributions

## RR Results and Commentary

### Macro Tests and Results: Negative Correlation

Altman, et al (2003);  
Chabanne, et al (2004);  
Tasche (2004, Schuermann (2004);  
Giése (2005); Hamilton (2004, 2005)

Confirming negative correlation between default rates and RR, including single and multiple factor models.

### Macro Tests: Qualifying Results

Jokivuolle and Peura (2000);  
Carey and Gordy (2003, 2004);  
Stevenson (2005); Araten et al (2004);  
Araten, et al (2005); Altman (2006)

Studies found non-significant correlations between PD and RR or negative correlation for bonds only in specific periods(1980s-1990s); positive for loans; unexpected high recoveries in 2005.

### Micro Tests: Firm Specific Recoveries

Van de Castle & Keisman (1998);  
Keisman (2004); Archarya, Bharath  
Srinivasan (2004); Friedmen (2003)

Importance of security's position in capital structure; industry impact on RR, substantial cross-section variability of recoveries

### Ratings Agency Treatment of RR

S&P (2003); Fitch (2005);  
Moody's (TBA)

Issuer Recovery Ratings on Senior Secured Loans (S&P);  
On speculative Grade Bonds and Loans (FITCH); Implicit in bond and loan ratings (prior methodology of Moody's); Explicit RR ratings (TBA).

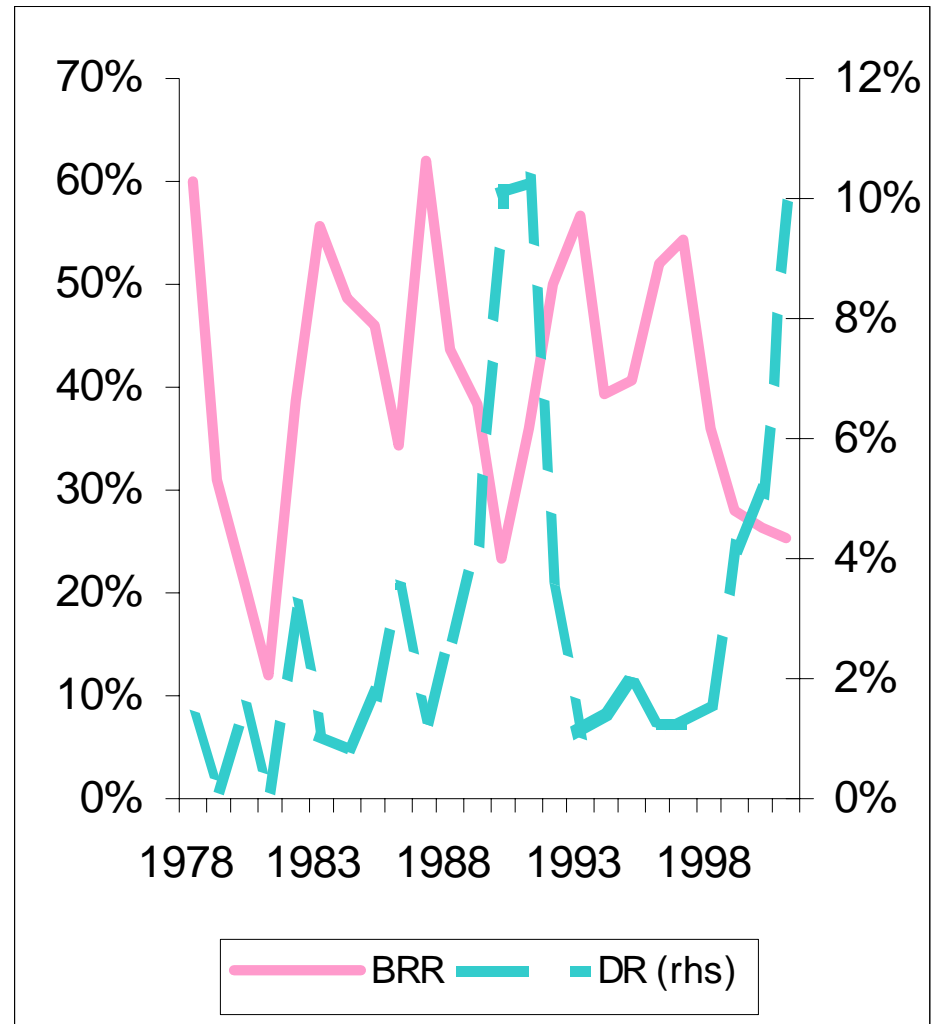
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# Structure of the sample

- About 1,000 bonds (NYU Salomon Center database) defaulted between 1978 and 2001
- Define BRR as weighted average price of defaulted bonds as close to default date as possible

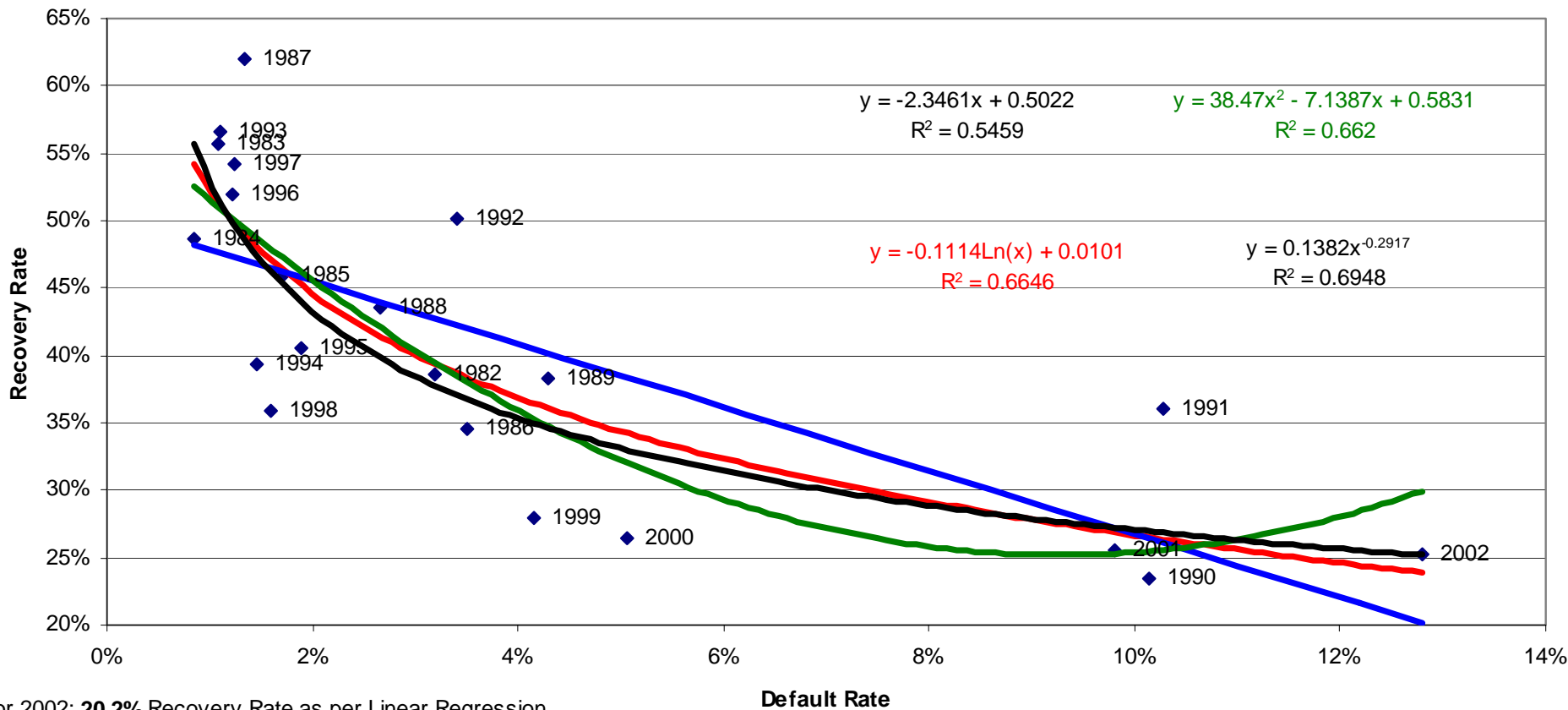


# The univariate picture

## RECOVERY RATE/DEFAULT RATE ASSOCIATION

*Altman Defaulted Bonds Data Set (1982-2002)*

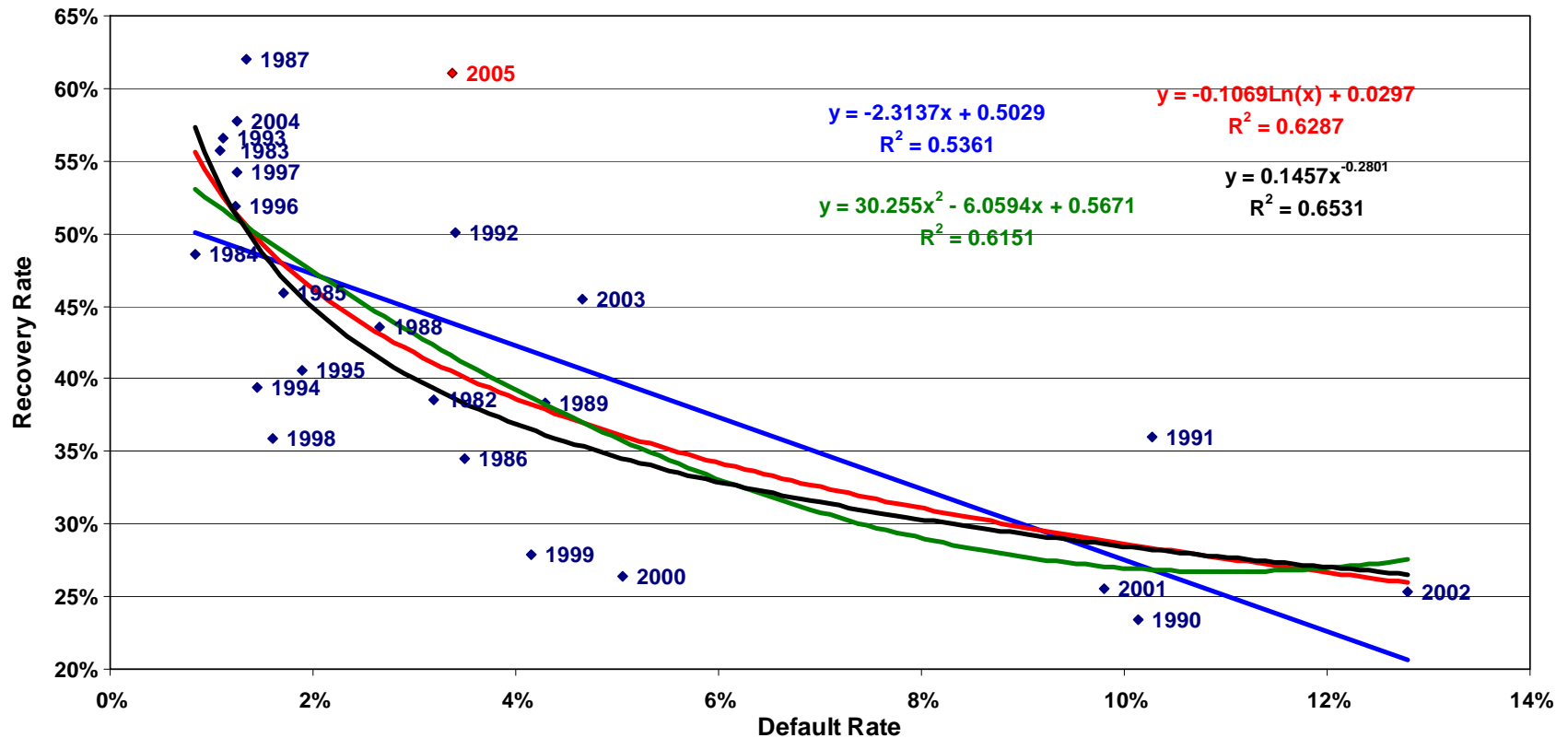
*Dollar Weighted Average Recovery Rates to Dollar Weighted Average Default Rates*



# Recovery Rate/Default Rate Association

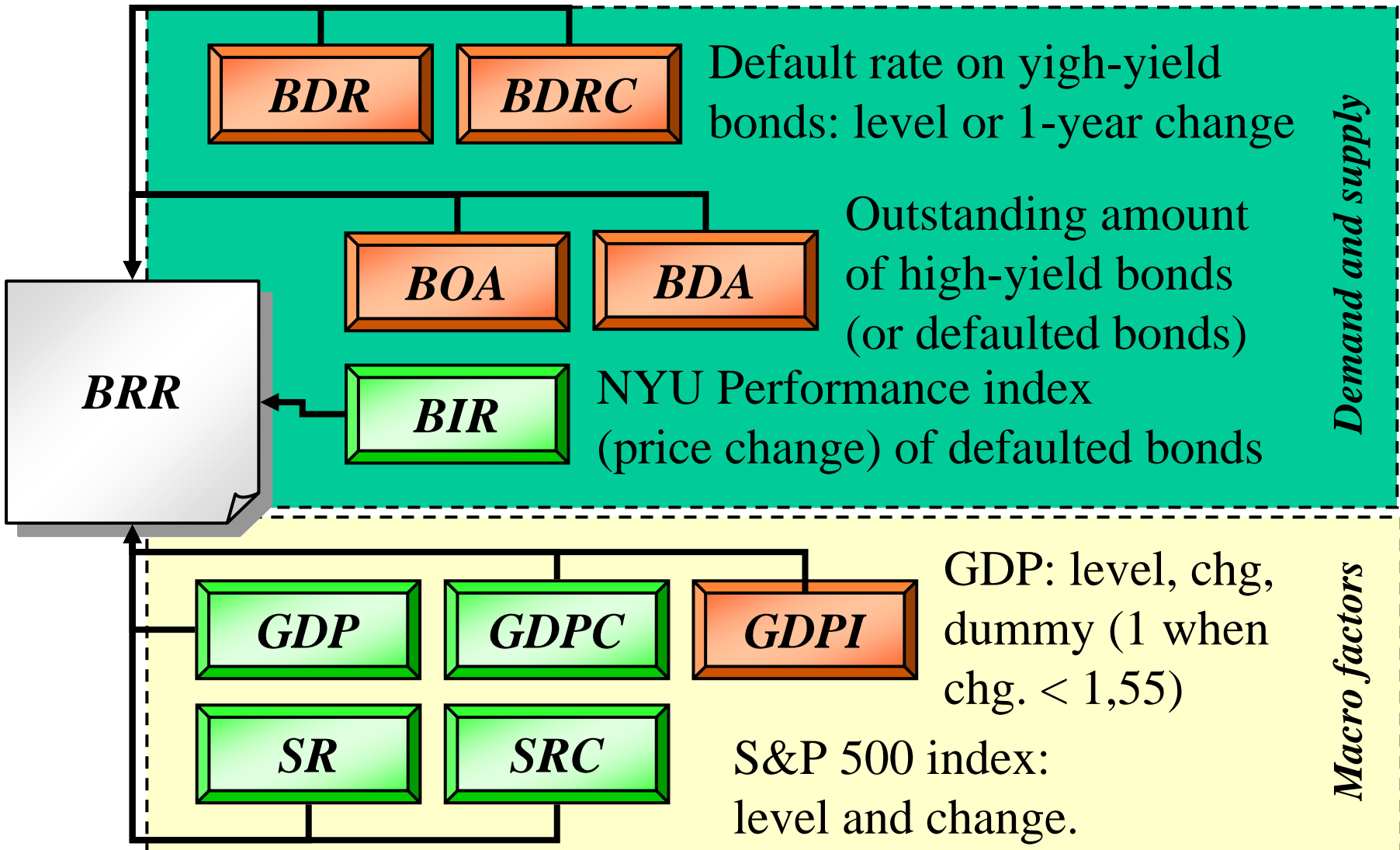
Altman Defaulted Bonds Data Set (1982-2005)

Dollar Weighted Average Recovery Rates to Dollar Weighted Average Default Rates



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

# Multivariate models: explanatory variables



# Some multivariate results

Dependent var.: BRR (log)			
	Model I	Model II	Model III
Constant	-1.55 (-9.27)	-1.29 (-4.51)	-1.02 (-6.36)
BDR (log)	-0.22 (-5.18)	-0.13 (-1.96)	
BDRC	-3.51 (-2.82)	-3.45 (-2.45)	-4.85 (-2.55)
BOA	-0.59 (-2.60)		-0.85 (-2.18)
BDA		-10.60 (-1.84)	
BIR	0.20 (1.28)	0.33 (2.14)	0.43 (1.63)
GDP			0.33 (2.14)
R-square	91%	89%	68%

*Supply and demand variables explain about 90% of BRR total variance*

*Macro factors are less significant: GDP is “crowded out” by BDR because of a strong (-67%) univariate correlation*

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# Recovery at Default\* on Public Corporate Bonds (1978-2004) and Bank Loans (1989-2004)

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<b>Loan/Bond Seniority</b>	<b>Number of Issues</b>	<b>Median</b>	<b>Mean %</b>	<b>Deviation</b>
Senior Secured Loans	251	69.34	75.00	24.40
Senior Unsecured Loans	52	53.23	49.25	28.40
Senior Secured Bonds	256	55.75	52.84	23.05
Senior Unsecured Bonds	947	42.54	34.89	26.62
Senior Subordinated Bonds	399	32.79	30.17	24.97
Subordinated Bonds	248	31.00	29.03	22.53
Discount Bonds	145	19.00	20.93	17.64
<b>Total Sample Bonds</b>	<b>1,995</b>	<b>40.05</b>	<b>34.31</b>	<b>24.87</b>

*\*Based on prices just after default on bonds and 30 days after default on loans.*

*Source: K. Emery (Moody's), 2004 (Bank Loans) and Altman & Aguiar, 2004 (Bonds).*

# Investment Grade vs. Non-Investment Grade (Original Rating) Prices at Default on Public Bonds (1974-2003)

<b>Bond Seniority</b>	<b>Number of Issues</b>	<b>Median Price %</b>	<b>Average Price %</b>	<b>Weighted Price %</b>	<b>Standard Deviation %</b>
<b>Senior Secured</b>					
Investment Grade	89	50.50	54.50	56.39	24.42
Non-Investment Grade	283	33.50	36.63	31.91	26.04
<b>Senior Unsecured</b>					
Investment Grade	299	42.75	46.37*	44.05*	23.57
Non-Investment Grade	598	30.00	33.41	31.83	23.65
<b>Senior Subordinated</b>					
Investment Grade	11	27.31	39.54	42.04	24.23
Non-Investment Grade	411	26.50	31.48	28.99	24.30
<b>Subordinated</b>					
Investment Grade	12	35.69	35.64	23.55	23.83
Non-Investment Grade	238	28.00	30.91	28.66	21.98
<b>Discount</b>					
Investment Grade	--	--	--	--	---
Non-investment Grade	113	16.00	20.69	21.24	17.23
<b>Total Sample</b>	<b>2,054</b>	<b>30.04</b>	<b>34.76</b>	<b>30.78</b>	<b>24.38</b>

Notes: (\*) Including WorldCom, the Average and Weighted Average were 43.53% and 30.45%  
 Non-rated issues were considered as non-investment grade

# Ultimate Recovery Rates on Bank Loan Defaults (Discounted Values, 1988-2004)

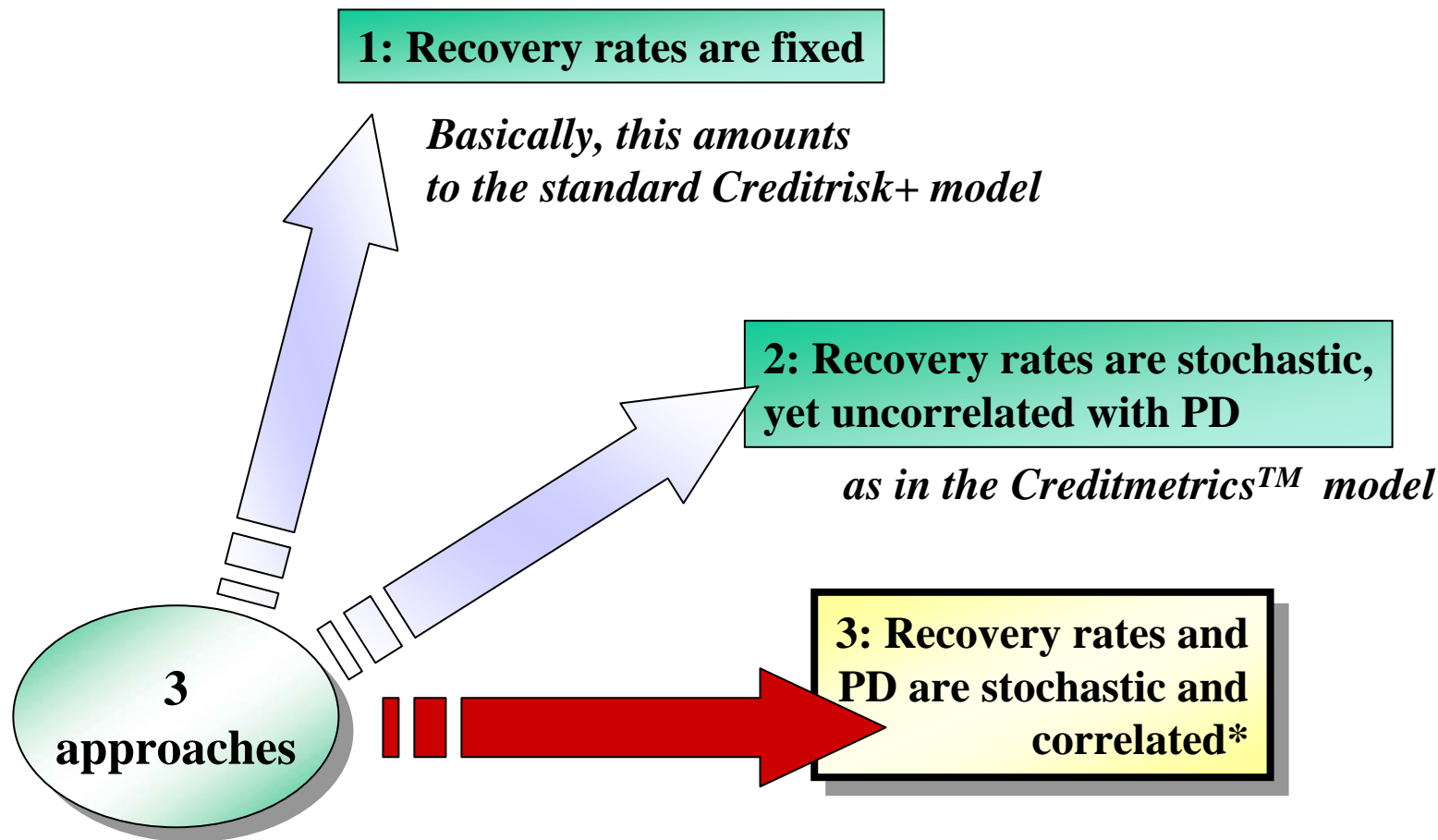
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	1988 – 2Q 2004	Observations	4Q 1998 – 2Q 2002	Observations
Bank Debt	77.1%	1,023	74.5%	302
Senior Secured Bonds	63.3%	259	49.0%	40
Senior Unsecured Bonds	42.7%	587	32.8%	142
Senior Subordinated Bonds	31.2%	433	17.2%	100
Subordinated Bonds	30.1%	374	14.6%	43

*Source: Keisman, 2004, from Standard & Poor's LossStats™ Database, 2084 defaulted loans and bond issues that defaulted between 1987-2004. Recoveries are discounted at each instruments' pre-default interest rate.*

# Detail: three approaches to recovery rates

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**\*High values for the macro factor (i.e., recession scenarios) bring in RRs close to 10%, while low values in the macro factor are associated with RRs of about 90%**

# Simulation results

		RR modeled according to approach:			Delta
		1	2	3	(3-1)/1
Expected loss		46.26	45.81	59.85	+29.4%
Standard errors		98.17	97.84	127.16	+29.5%
VaR	95	190	188	245	+28.9%
	99	435	437	564	+29.6%
	99.5	549	546	710	+29.3%
	99.9	809	815	1,053	+30.1%

...both unexpected and **expected** losses  
are **severely underestimated**

Moreover, **cyclical swings may be stronger than expected**

# The procyclicality issue

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- As the economic **cycle worsens**, so do ratings.
  - This means that, under the new rating-based Basel rules, a bank would have to raise more capital or to **reduce its loan book**
  - The latter would **make economic slowdowns even worse...**
- In the “advanced” internal rating-based approach proposed by the BCBS, banks are allowed to use their own **estimates of recovery rates**
  - **What if these estimates are reduced as the economy slows, when the supply of defaulted assets increases?**

# The procyclicality issue: a simulation exercise

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- Suppose we set up a bank in 1980:
  - Its loan mix (by rating) is set according to a sample of 26 US banks (Treacy and Carey, 2000) or to the average portfolio mix of Italian banks (Marullo, 2000)
- Let the bank's loans migrate across rating classes according to S&P's transition matrices

	<i>1980</i>	<i>1990</i>	<i>2000</i>
<i>AAA</i>	3%	3%	2%
<i>AA</i>	5%	7%	9%
<i>A</i>	13%	20%	25%
<i>BBB</i>	28%	25%	30%
<i>BB</i>	39%	21%	19%
<i>B</i>	10%	20%	14%
<i>CCC</i>	2%	4%	2%

Bad quality loans  
increase in bad times  
(e.g., in 1990)

# Final remarks

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- The link between DR and RR has an important impact on some relevant issues
  - Expected losses and reserves
  - Unexpected losses and credit VaR measures
  - Procyclicality and overall adequacy of the new Basel rules
- Bond market data suggest that this link might be present across the cycle
- More research on typical bank data is needed.
- More research on the link between recovery rates at default and ultimate recovery rates (upon emergence).