6. RECOVERY ISSUES

➢ Most papers have focused on modeling the default intensity process.

➢ Recovery issues are often ignored.

➢ When treated it is common to make unrealistic assumptions about the recovery

o Constant recovery

o Stochastic recovery

BUT <u>independent</u> of the default arrival

Empirical Facts:

o Recovery rates change over time, in a stochastic way.

o PD and LGD are correlated

RECOVERY MODELS

- In the literature, we found models dealing differently with RR, from assuming that RR is exogenous to stochastic RR.

	MAIN MODELS & RELATED EMPIRICAL STUDIES	TREATMENT OF LGD	RELATIONSHIP BETWEEN RR AND PD
	Credit Pricing Models		
First generation structural-form models	Merton (1974), Black and Cox (1976), Geske (1977), Vasicek (1984), Crouhy and Galai (1994), Mason and Rosenfeld (1984).	PD and RR are a function of the structural characteristics of the firm. RR is therefore an endogenous variable.	PD and RR are inversely related (see Appendix A).
Second generation structural-form models	Kim, Ramaswamy e Sundaresan (1993), Nielsen, Saà-Requejo, Santa Clara (1993), Hull and White (1995), Longstaff and Schwartz (1995).	RR is exogenous and independent from the firm's asset value.	RR is generally defined as a fixed ratio of the outstanding debt value and is therefore independent from PD.
Reduced-form models	Litterman and Iben (1991), Madan and Unal (1995), Jarrow and Turnbull (1995), Jarrow, Lando and Turnbull (1997), Lando (1998), Duffie and Singleton (1999), Duffie (1998) and Duffee (1999).	Reduced-form models assume an exogenous RR that is either a constant or a stochastic variable independent from PD.	Reduced-form models introduce separate assumptions on the dynamic of PD and RR, which are modeled independently from the structural features of the firm.
Latest contributions on the PD-RR relationship	Frye (2000a and 2000b), Jarrow (2001), Carey and Gordy (2003), Altman, Brady, Resti and Sironi (2001 and 2004).	Both PD and RR are stochastic variables which depend on a common systematic risk factor (the state of the economy).	PD and RR are negatively correlated. In the "macroeconomic approach" this derives from the common dependence on one single systematic factor. In the "microeconomic approach" it derives from the supply and demand of defaulted securities.
	Credit Value at Risk Models		
CreditMetrics®	Gupton, Finger and Bhatia (1997).	Stochastic variable (beta distr.)	RR independent from PD
CreditPortfolioView®	Wilson (1998).	Stochastic variable	RR independent from PD
CreditRisk+®	Credit Suisse Financial Products (1997).	Constant	RR independent from PD
KMV CreditManager®	McQuown (1997), Crosbie (1999).	Stochastic variable	RR independent from PD

Loss determinants

- Collateral

- Debt seniority

- Loan type (namely for individuals)

- Region

- Business cycle

- Economic sector

- PD

LGD features

1. Most of the time, recovery as a percentage of exposure is either relatively high (around 70-80%) or low (around 20-30%).

2. The recovery (or loss) distribution is said to be "bimodal" (two-humped).

3. "Average" RR or LGD can be very misleading.

4. Relevance of seniority or subordination degree

5. Recoveries are systematically lower in recessions (until one-third lower).

6. Industry of the obligor seems to matter: tangible asset-intensive industries, especially utilities, have higher recovery rates than service sector firms, with some exceptions such as high tech and telecom.

7. Size of exposure seems to have no strong effect on losses.

Statistics

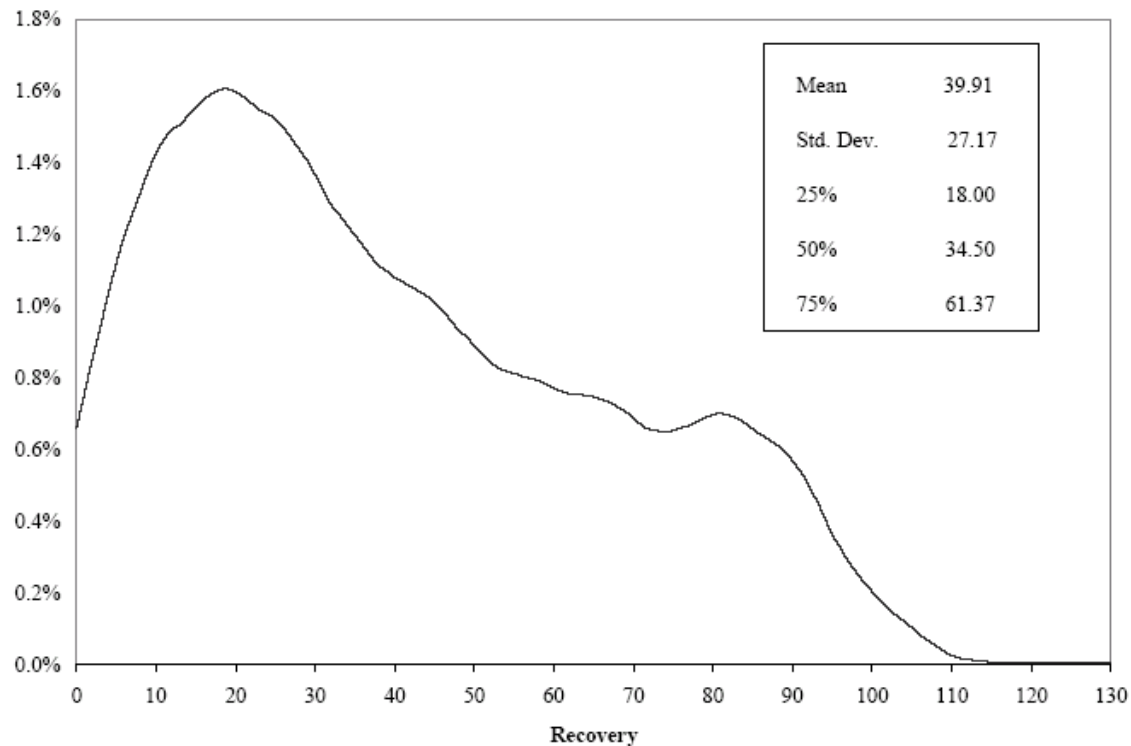- Recoveries exhibit a bimodal distribution:

Figure 1: Probability Distribution of Recoveries, 1970-2003: All Bonds & Loans (Moody's)

Source: Schuermann (2004)
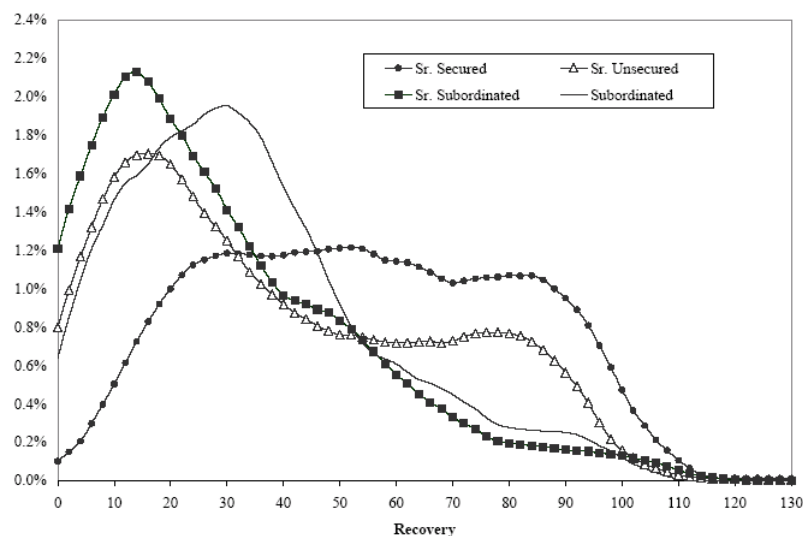
Seniority

- Higher recoveries in senior debt:

Figure 2: Probability Densities of Recovery by Seniority (Moody's, 1970-2003)

Source: Schuermann (2004) and Moody's (2009)

Average Annual Bond and Loan Recovery Rates[1]

Year	Loan Sr. Sec.[2]	Bond Sr. Sec.	Bond Sr. Unsec.	Bond Sr. Sub.	Bond Sub.	Bond Jr. Sub.	All Bonds
1982	n.a.	72.50%	35.79%	48.09%	29.99%	n.a.	35.57%
1983	n.a.	40.00%	52.72%	43.50%	40.54%	n.a.	43.64%
1984	n.a.	n.a.	49.41%	67.88%	44.26%	n.a.	45.49%
1985	n.a.	83.63%	60.16%	30.88%	39.42%	48.50%	43.66%
1986	n.a.	59.22%	52.60%	50.16%	42.58%	n.a.	48.38%
1987	n.a.	71.00%	62.73%	44.81%	46.89%	n.a.	50.48%
1988	n.a.	55.40%	45.24%	33.41%	33.77%	36.50%	38.98%
1989	n.a.	46.54%	43.81%	34.57%	26.36%	16.85%	32.31%
1990	75.25%	33.81%	37.01%	25.64%	19.09%	10.70%	25.50%
1991	74.67%	48.39%	36.66%	41.82%	24.42%	7.79%	35.53%
1992	61.13%	62.05%	49.19%	49.40%	38.04%	13.50%	45.89%
1993	53.40%	n.a.	37.13%	51.91%	44.15%	n.a.	43.08%
1994	67.59%	69.25%	53.73%	29.61%	38.23%	n.a.	45.57%
1995	75.44%	62.02%	47.60%	34.30%	41.54%	n.a.	43.28%
1996	88.23%	47.58%	62.75%	43.75%	22.60%	n.a.	41.54%
1997	78.75%	75.50%	56.10%	44.73%	35.96%	30.58%	49.39%
1998	51.40%	46.82%	41.63%	44.99%	18.19%	62.00%	39.25%
1999	75.82%	43.00%	38.04%	28.01%	35.64%	n.a.	34.33%
2000	68.32%	39.23%	23.81%	20.75%	31.86%	15.50%	25.18%
2001	64.87%	37.98%	21.45%	19.82%	15.94%	47.00%	22.21%
2002	58.80%	48.37%	29.69%	21.36%	24.51%	n.a.	29.95%
2003	73.43%	63.46%	41.87%	37.18%	12.31%	n.a.	40.72%
2004	87.74%	73.25%	52.09%	42.33%	94.00%	n.a.	58.50%
2005	83.78%	71.93%	54.88%	26.06%	51.25%	n.a.	55.97%
2006	83.60%	74.63%	55.02%	41.41%	56.11%	n.a.	55.02%
2007	68.63%	80.54%	53.25%	54.47%	n.a.	n.a.	54.69%
2008	63.38%	57.98%	33.80%	23.02%	23.56%	n.a.	34.83%

1. Issuer-weighted, based on 30-day post-default market prices.
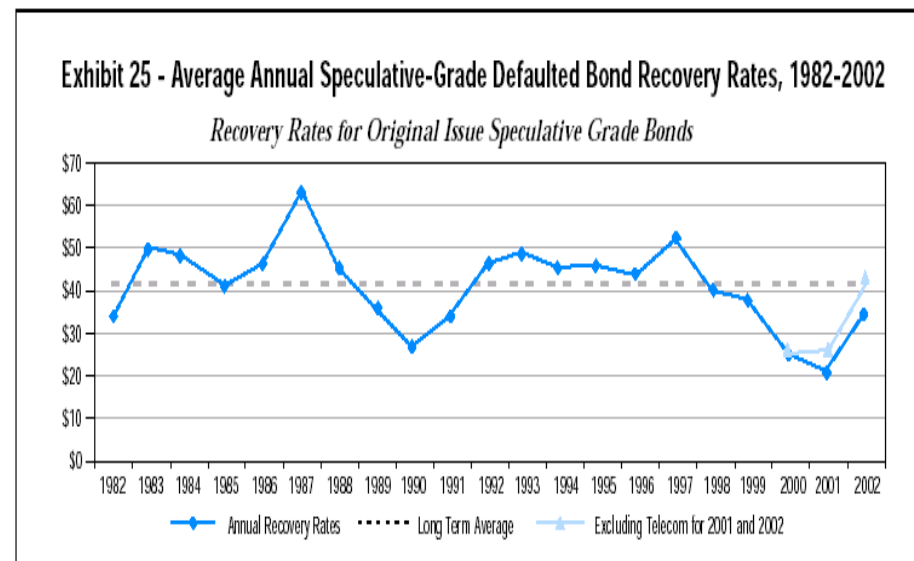2. Second-lien loans excluded.

Business Cycle

○ LGD is typically higher during the lower stages of the business cycle.
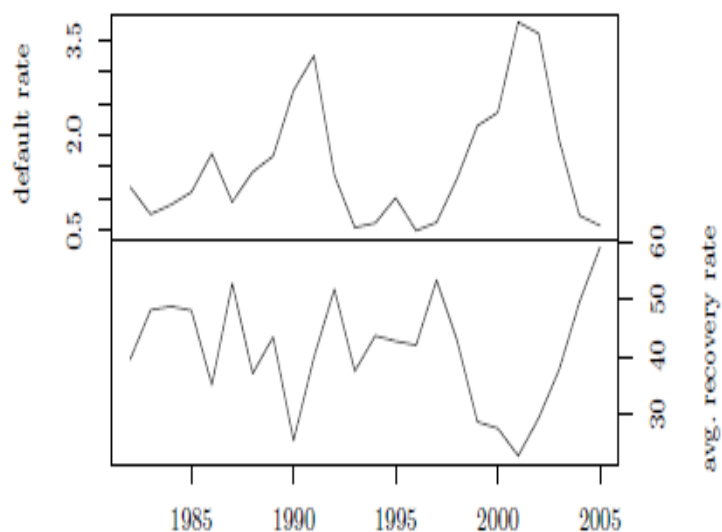
Source: Bruche, Max and Carlos Gonzalez-Aguado (2007), "Recovery Rates, Default Probabilities and the Credit Cycle".
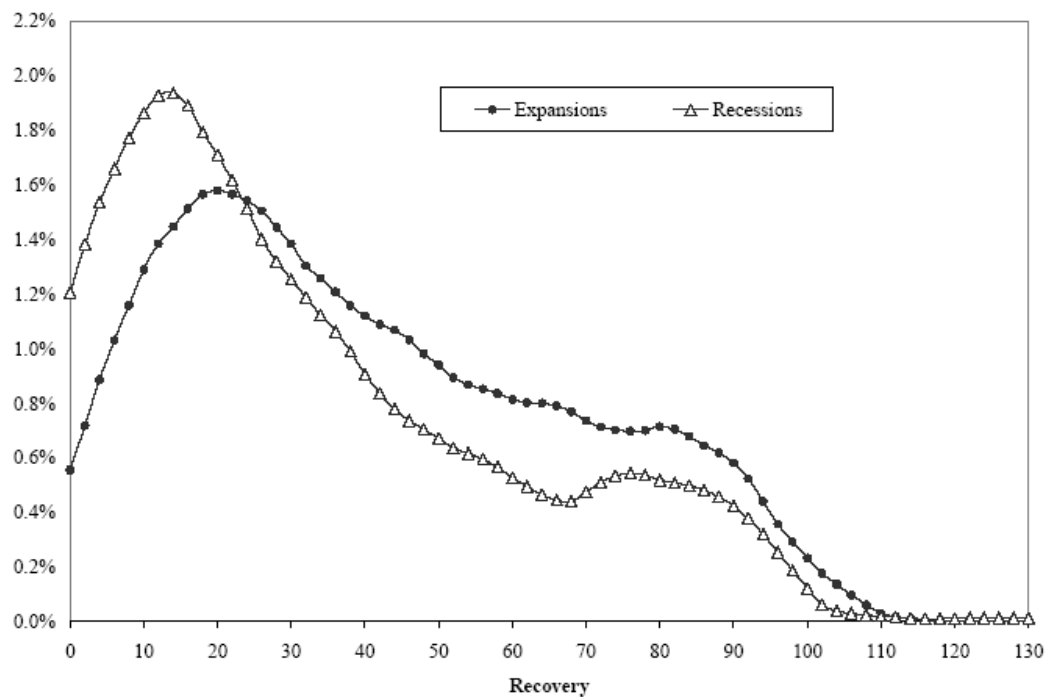

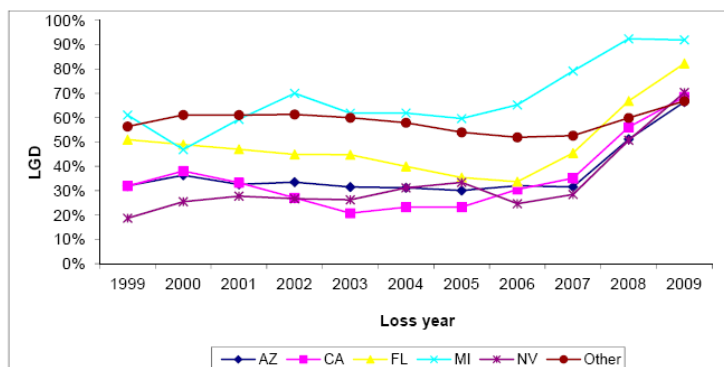Source: Moody's (2003).

Business Cycle

Figure 4: Probability Densities of Recoveries across the Business Cycle (Moody's, 1970-2003)

Source: Schuermann (2004)

Region

○ Often regions where customers are based exhibit different recovery perspectives, namely due to differences in economic sectors operating:

Figure 4: LGD over Loss Years by State

Source: Zhang, Yanan Lu Ji and Fei Liu (2010), "Local Housing Market Cycle and Loss Given Default: Evidence from Sub-Prime Residential Mortgages", IMF WP WP/10/167.

Table 5.5: Discounted recovery rates by country (12%)

|	Mean	Median	Std. dev.	No. in sample
U.K.	65.8%	82.8%	36.4%	92
France	38.0%	31.9%	33.6%	336
Germany	54.9%	56.7%	24.0%	35
Total				463

Source: Franks *et al* (2004).

Economic Sectors

○ In Altman and Kishore (1996), differences between sectors are identified.

○ The LGD is usually higher for sectors with higher PD.

Exhibit 16 - Average Recovery Rates by Industry Category

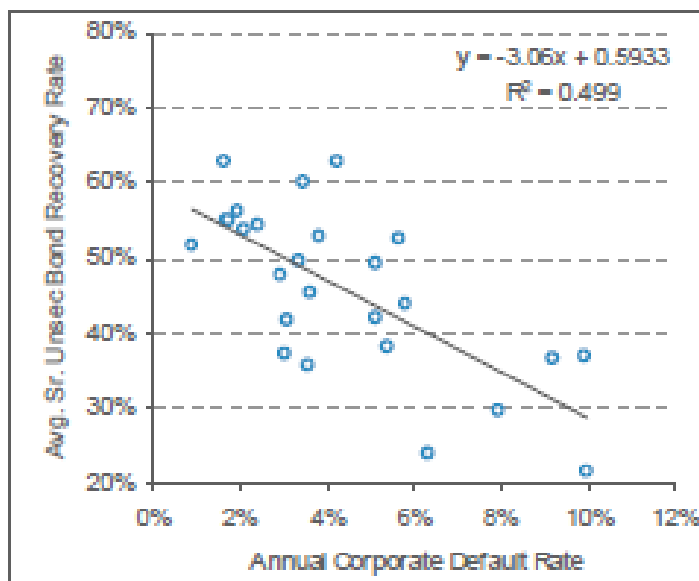| Industry	Issuer Weighted Mean Recovery Rate		
	2003	2002	1982-2003
Utility-Gas	48.0	54.6	51.5
Oil and Oil Services	NA	44.1	44.5
Hospitality	64.5	60.0	42.5
Utility-Electric	5.3	39.8	41.4
Transport-Ocean	76.8	31.0	38.8
Media, Broadcasting and Cable	57.5	39.5	38.2
Transport-Surface	NA	37.9	36.6
Finance and Banking	18.8	25.6	36.3
Industrial	33.4	34.3	35.4
Retail	57.9	58.2	34.4
Transport - Air	22.6	24.9	34.3
Automotive	39.0	39.5	33.4
Healthcare	52.2	47.0	32.7
Consumer Goods	54.0	22.8	32.5
Construction	22.5	23.0	31.9
Technology	9.4	36.7	29.5
Real Estate	NA	5.0	28.8
Steel	31.8	28.5	27.4
Telecommunications	45.9	21.4	23.2
Miscellaneous	69.5	46.5	39.5

Source: Moody's (2004).

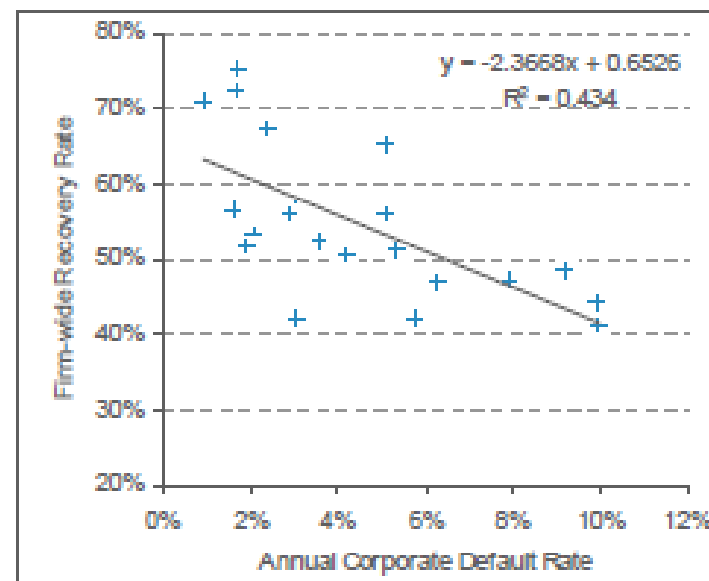Recovery Rates by Industry Group
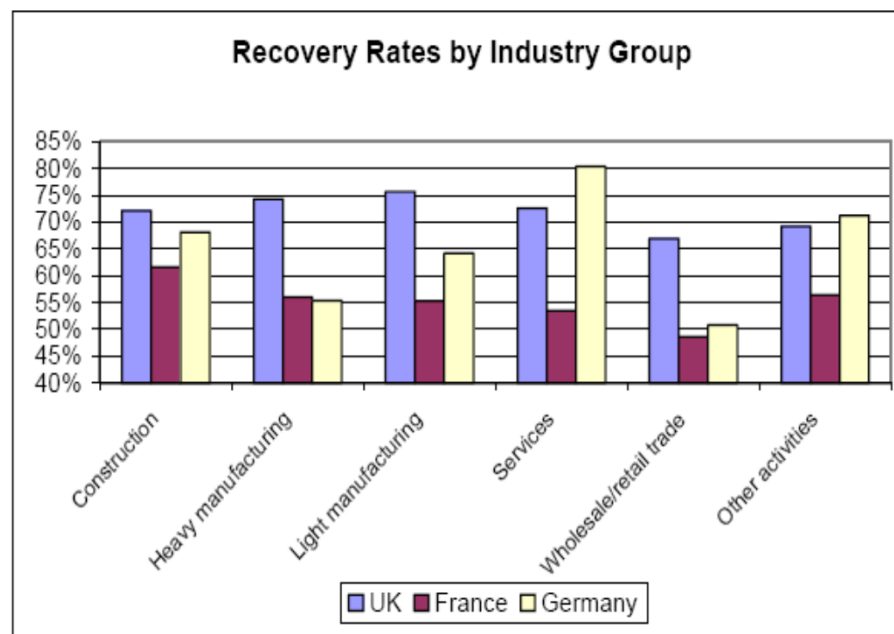
Source: Franks *et al* (2004).

PD

○ The correlation between LGD and PD along time is high (0.66 according to S&P (2007)).

Source: Moody's (2008).
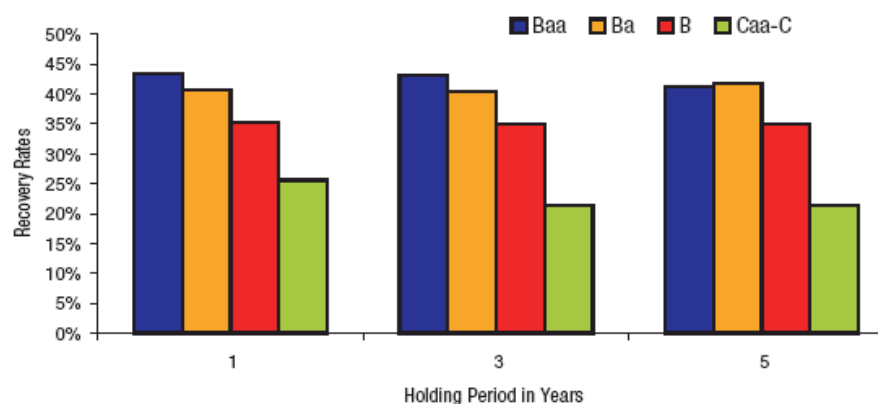
PD

○ Higher ratings typically exhibit lower LGDs:

Source: Moody's (2003; 2008).

Holding Period senior Unsecured Issuer-Weighted Mean Recovery Rates

Legend: ■ Baa ■ Ba ■ B ■ Caa-C

Average Sr. Unsecured Bond Recovery Rates by Year Prior to Default, 1982-2008[1]

	Year 1	Year 2	Year 3	Year 4	Year 5
Aaa	n.a.	3.33%[2]	n.a.	97.00%	85.55%
Aa	43.60%	40.15%	43.45%	57.61%	43.40%
A	42.48%	45.45%	44.50%	38.28%	40.95%
Baa	41.85%	44.56%	44.09%	45.44%	42.68%
Ba	48.00%	42.68%	41.58%	41.15%	41.12%
B	36.98%	35.41%	35.88%	36.91%	40.68%
Caa-C	33.96%	33.25%	33.11%	39.59%	41.94%
Investment-Grade	42.05%	44.23%	44.24%	44.57%	43.37%
Speculative-Grade	36.26%	35.71%	36.30%	38.26%	40.90%
All Rated	36.56%	36.65%	37.50%	39.52%	41.51%

1. Issuer-weighted, based on 30-day post default market prices.
2. Based on three Icelandic bank defaults.

Estimation Methods

- NPV of recoveries

- Recovery distributions

- Bond prices after default

- LGD implied in bond prices

- LGD implied in observed losses and in PD estimates.

- Econometric adjustment of the LGD as a function of several variables (LossCalc, Moody's (2002)).

Table 9

Classification of the objective methods to obtain LGDs

Source	Measure	Type of facilities in the RDS		Most applicable to
		Defaulted facilities	**Non-defaulted facilities**	
Market values	Price differences	Market LGD		Large corporate, sovereigns, banks
	Credit spreads		Implied market LGD	Large corporate, sovereigns, banks
Recovery and cost experience	Discounted cash flows	Workout LGD		Retail, SMEs, large corporate
	Historical total losses and estimated PD	Implied historical LGD		Retail

Source: Basel Committee on Banking Supervision (2005)

Listed bonds

- Usually, in these exposures the LGD is measured as 1-Price (as a % of EAD) in a given period (usually 1 month after the default).

- Empirical evidence points to LGDs between 30% and 40% in non-colateralized exposures (around 60% for collateralized loans).

Average Corporate Debt Recovery Rates Measured by Post-Default Trading Prices

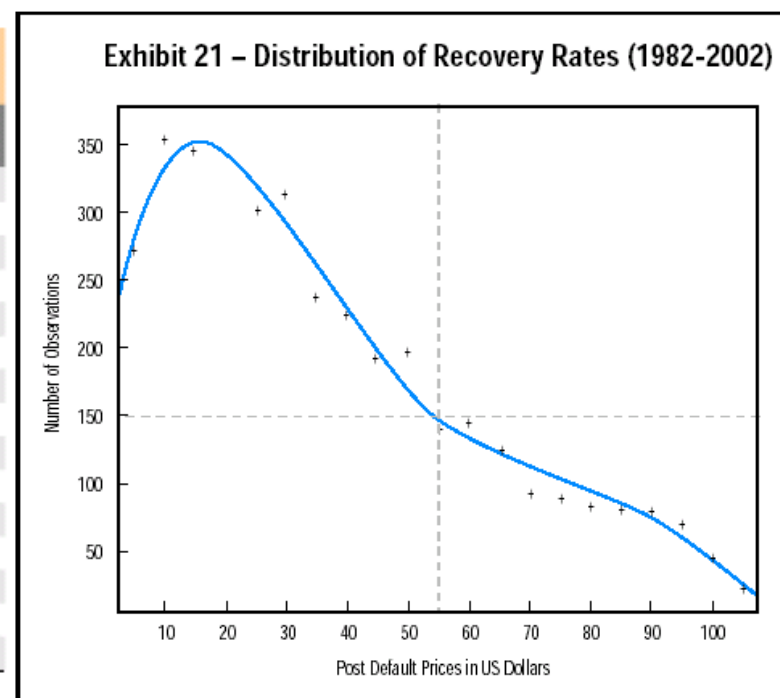| LIEN POSITION	ISSUER-WEIGHTED			VALUE-WEIGHTED		
	2009	2008	1982-2009	2009	2008	1982-2009
1st Lien Bank Loan	54.0%	61.7%	65.6%	56.6%	46.9%	59.1%
2nd Lien Bank Loan	16.0%	40.4%	32.8%	20.5%	36.6%	31.9%
Sr. Unsecured Bank Loan	34.5%	31.6%	48.7%	38.1%	22.8%	40.0%
Sr. Secured Bond	37.5%	54.9%	49.8%	29.5%	40.3%	48.5%
Sr. Unsecured Bond	37.7%	33.8%	36.6%	35.5%	26.2%	32.6%
Sr. Subordinated Bond	22.4%	23.7%	30.7%	17.9%	10.4%	25.0%
Subordinated Bond	46.8%	23.6%	31.3%	24.7%	7.3%	23.5%
Jr. Subordinated Bond	n.a.	n.a.	24.7%	n.a.	n.a.	17.1%

Source: Moody's (2010).

Listed bonds

■ Just like in PDs, LGD distribution typically exhibits a high right tail, with the mode being low:

Senior Unsecured Bond Recovery Rates for Financial Institution Defaults in 2008[1]			
Company	Domain	Default Volume ($Mil)	Sr. Unsecured Bond Recovery
Lehman Brothers Holdings, Inc.	United States	120,164	9.3%
Kaupthing Bank hf	Iceland	20,063	4.0%
Glitnir banki hf	Iceland	18,773	3.0%
GMAC LLC	United States	17,190	69.9%
Washington Mutual Bank	United States	13,600	26.5%
Residential Capital, LLC	United States	12,315	51.7%
Landsbanki Islands hf	Iceland	12,161	3.0%
Washington Mutual, Inc.	United States	5,746	57.0%
GMAC of Canada Ltd	Canada	265	70.7%
Downey Financial Corp.	United States	200	0.5%
Fremont General Corporation	United States	166	46.0%
Luminent Mortgage Capital, Inc.	United States	131	27.3%
Triad Financial Corporation	United States	89	76.5%
Franklin Bank Corp.	United States	80	0.0%
GMAC International Finance B.V.	Netherlands	51	85.5%
Average		35.4%	Median 27.3%

Source: Moody's (2009).

Exhibit 21 – Distribution of Recovery Rates (1982-2002)

Source: Moody's (2003).