

Statistical Issues in Managing the Credit Risk of Derivatives

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Overview

- derivatives
- credit risk
- risk mitigation
- use of collateral
- intermediation
- capital adequacy
- portfolio management

Derivatives:

Over-the-counter derivatives contract:

- two-party agreement to exchange cash flows;
- lasts for a specified period of time;
- cash flows determined by future market rates, e.g. interest rates.

Marking to Market

Mark-to-Market value:

- net present value (NPV) of remaining cash flows.

Mark-to-market value changes over time:

- with market rates;
- as deal matures.

Credit Risk

Default Risk:

- one party may fail to honor contract;
- standard contract requires prompt settlement of NPV (of this and all other contracts);
- other party is an unsecured creditor, unless security is provided.

How much risk?

Party A loses money if:

- Party B defaults, and
- NPV to A is positive, and
- recovery is less than 100%

One-year transition probabilities (%):

	AAA	AA	A	BBB	BB	B	CCC	D	NR
AAA	88.72	8.14	0.66	0.06	0.12	0.00	0.00	0.00	2.29
AA	0.68	88.31	7.59	0.62	0.06	0.14	0.02	0.00	2.58
A	0.09	2.19	87.74	5.32	0.71	0.25	0.01	0.06	3.64
BBB	0.02	0.31	5.61	81.95	5.00	1.10	0.11	0.18	5.72
BB	0.03	0.13	0.61	7.03	73.27	8.04	0.91	1.06	8.93
B	0.00	0.10	0.21	0.38	5.66	72.91	3.56	5.20	11.98
CCC	0.18	0.00	0.18	1.07	1.96	9.27	53.48	19.79	14.08
D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
NR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00

Cumulative default rates (% , Markov model):

Year	1	2	3	4	5	6	7	8	9	10
AAA	0.00	0.00	0.01	0.02	0.03	0.06	0.08	0.12	0.16	0.21
AA	0.00	0.02	0.05	0.10	0.16	0.23	0.32	0.42	0.53	0.65
A	0.06	0.14	0.26	0.40	0.56	0.75	0.96	1.18	1.41	1.66
BBB	0.18	0.46	0.83	1.26	1.74	2.24	2.74	3.25	3.74	4.21
BB	1.06	2.45	3.95	5.44	6.85	8.14	9.29	10.30	11.19	11.96
B	5.20	9.76	13.55	16.64	19.10	21.07	22.63	23.88	24.87	25.66
CCC	19.79	30.88	37.26	41.06	43.41	44.93	45.96	46.68	47.21	47.60

Historical multi-year rates are higher.

Mitigating Risk: Collateral

Party A's NPV > 0 .

Party A requests collateral (Treasury securities) from Party B.

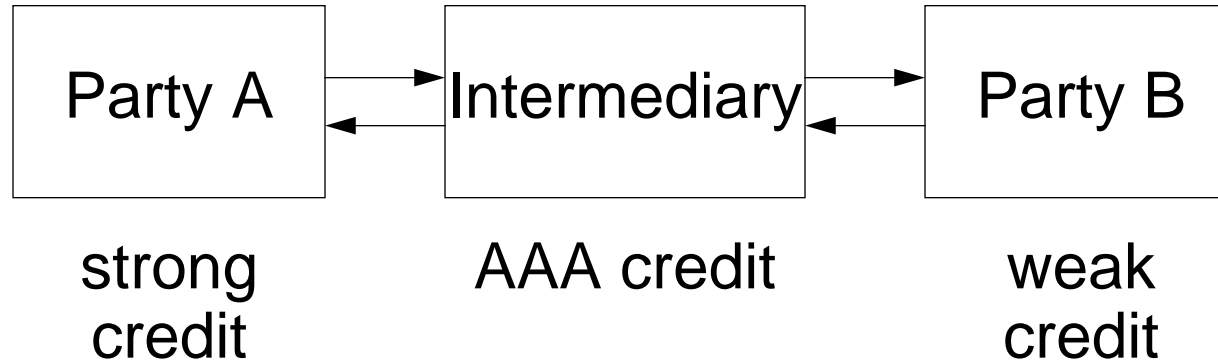
How much?

- Market value of collateral = C ;
- B defaults at most d days later;
- Want $P(C + \delta C > NPV + \delta NPV) > 1 - \varepsilon$.

Must:

- specify d and ε ;
- find distribution of $\delta NPV - \delta C = \delta(NPV - C)$

Mitigating Risk: Intermediation



Possible Intermediaries:

- third party;
- Credit-enhanced Derivative Product Company (“DPC”) wholly owned by Party B.

Credit Enhancement

How does DPC rate higher than B?

- bankruptcy-remote;
- no market risk;
- no credit exposure to B (collateral);
- enough capital to withstand other credit losses.

DPC Structures

Continuation Vehicle:

- survives insolvency of parent;
- Contingent Manager steps in;
- contracts run to maturity.

Termination Vehicle:

- all contracts terminate on insolvency of parent;
- NPV exchanged promptly with all counterparties.

Capital Adequacy

Rating agencies require

$$P(\text{credit losses} > \text{capital}) > 1 - \varepsilon$$

or similar.

$$\text{Overall credit loss} = \sum \text{Counterparty loss}$$

$$\text{Counterparty loss} = \min\{0, \text{NPV}(\tau)\}$$

τ = time of counterparty event

Capital Adequacy

Assumptions:

1. $NPV(t)$ -

- depends on market rates at t ;
- not independent across counterparties.

2. τ –

- need joint distribution;
- $\tau = \min\{\tau(\text{counterparty}), \tau(\text{sovereign})\}$
- independence plausible (perhaps conditionally on market conditions).

Capital Adequacy

Computational strategy:

- condition on market path;
- conditional distribution of credit loss depends on distribution of τ 's (and path);
- conditional independence \Rightarrow distribution of sum is convolution;
- get unconditional distribution by averaging over market paths (simulation);

Optimization

Capital and collateral cost money.

Required levels of both depend on portfolio of contracts:

- credit ratings of counterparties;
- sensitivity of NPV's to market fluctuations.

Portfolio can be managed to control costs.

Summary

Probability modelling and statistical analysis play role in:

- mitigating credit risk, either through use of collateral or through structuring a special purpose intermediary;
- efficiently managing a portfolio of derivatives.