

The Effect of Credit Risk on Derivative Pricing

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Market Risk vs. Credit Risk

- Tradable assets
 - “ready for sale” → daily mark to market → standard VaR
 - assets are usually limited liability assets, with no negative payoff
 - (e.g., stocks, currencies, etc)
 - **market risk is relevant**
- Non-tradable assets (e.g., loans)
 - “long term book” → no mark to market
 - **credit risk is relevant**
- ...hence, there is usually a clear separation
- Except for the case of **derivatives**
(think of the payoff function of swaps, forwards, options)

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Systemic Risk of OTC derivatives: A Decade-Old Problem

...Since Merrill's loss on CMOs in the early 90s, to Nick Leeson at Barings to LTCM, OTC derivatives have been a matter of great concern:

- Greenspan

We must all guard against a situation in which traders lack the expertise to evaluate the attendant risks, and ... senior managers are too embarrassed to admit they don't understand them

- Corrigan

...the growth and complexity of derivatives ... and the nature of the credit risk they entail should give us all a cause for concern

The Interest Rate Sensitivity of a Swap: a short review

- **How do we MTM a Swap?**

SWAP == (long floater) + (short fixed bond)

- The interest rate sensitivity is driven primarily by the short fixed bond component.
- For our purposes, note that the critical relevant characteristic is that the IRS has **no principal amount at stake**

Credit Risk Issues Arise

- The swap curve indicates how much a dealer would pay / receive in a swap with an investment grade counterparty
- Interesting to note: Spreads does not seem to be rating sensitive!

DOES IT MAKE SENSE?

- Some argue that credit risk is underpriced in the swaps market, since swap spreads are much lower than corporate credit spreads.
- **However, swaps have many special features, which substantially reduce their credit risk.**

Loans

- Full principal at risk
- Full interest payments at risk
- Defaults always matter
- Covenants apply

Swaps

- **No principal at risk**
- Only a spread payment at risk
- Default matters only if in the money
- Contracts often have rating-related unwind/settlement triggers and advanced credit enhancement and collateralization features

Credit Enhancement

- The most "matured" setting can be found on organized exchanges
- The OTC market provides a variety of standard (ISDA master agreement) and new (asset/counterparty-specific) additions

Credit Enhancement: the Case of Exchanges

- Options and futures **margin** requirements
 - » margin serves as a collateral
- Daily **mark-to-market** and possible liquidation of a position
 - » margin is proportional to avg. vol
 - » margin may be related to the nature of the trade (hedging or speculative)
- **Position limits** vis-a-vis each counterparty helps diversify default risk
- Cross-clearing agreements
- *The system is, however, not fool-proof*
(e.g., the case of Barings)

Credit Enhancement: OTC Derivatives

- Netting Arrangements
 - » bilateral close-out is now standard in the ISDA master swap agreement
- Position Limits
 - » RM group monitors the "exposure profile" for each counterparty
 - » each trade is considered for its portfolio effect
- Margins and Collateral
 - » common to require dynamic margining

Credit Enhancement: OTC Derivatives

Continued

- Derivative Product Companies (SPVs)
 - » Dynamically capitalized to maintain AA / AAA -rating
 - » Often a requirement of sovereigns
- Re-couponsing
 - » MTM-triggered payment and recouponsing brings transaction to market
- Credit Triggers
 - » If a counterparty falls below investment grade, the other counterparty may require an immediate cash settlement (of questionable effectiveness)
 - » Common for long-dated swaps

Credit Exposure

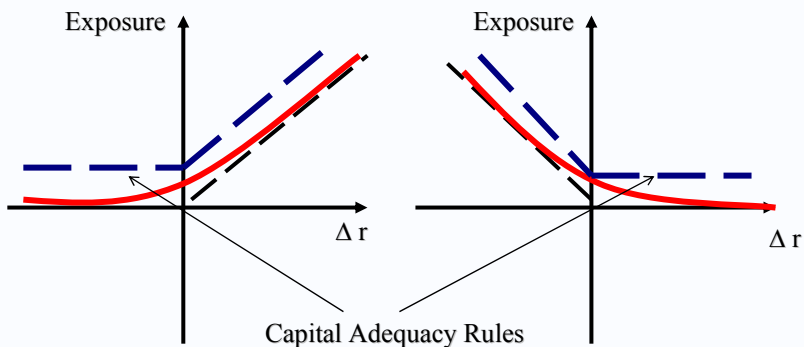
...So, what are the key factors affecting the exposure of derivatives?

- Current fair value
- Potential exposure
 - » Time to maturity
 - » The time series properties of the underlying
 - » ...
- Effect of netting, collateral and margin
- Probability of default
- Priority of claimants upon default
- (+ the effect of deviations from absolute priority?)
- Recovery rate

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Capital Adequacy Rules

The rules account for time to expiration and the degree of moneyness of the default option



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Capital Ratios

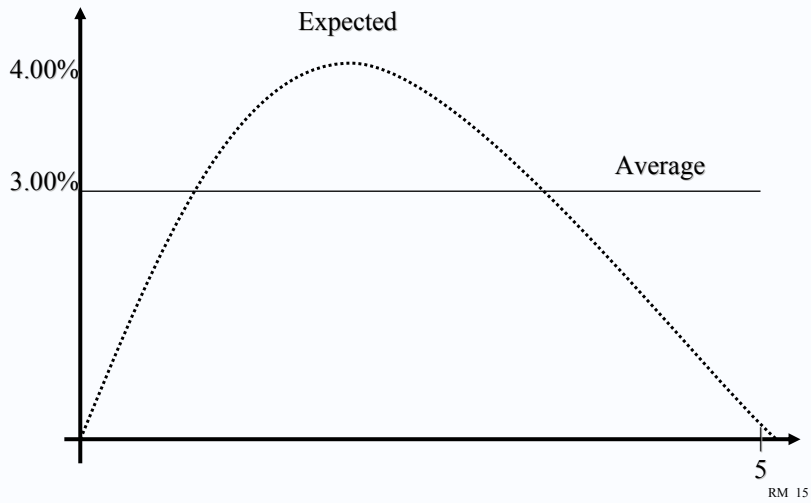
The 88 Basel Accord

	<u><1yr</u>	<u>1-5 Yr</u>	<u>> 5yr</u>
Int. Rates	0	1	1.5
Ex Rates	1	5	7.5
Equity	6	8	10
Commodity	10	12	15

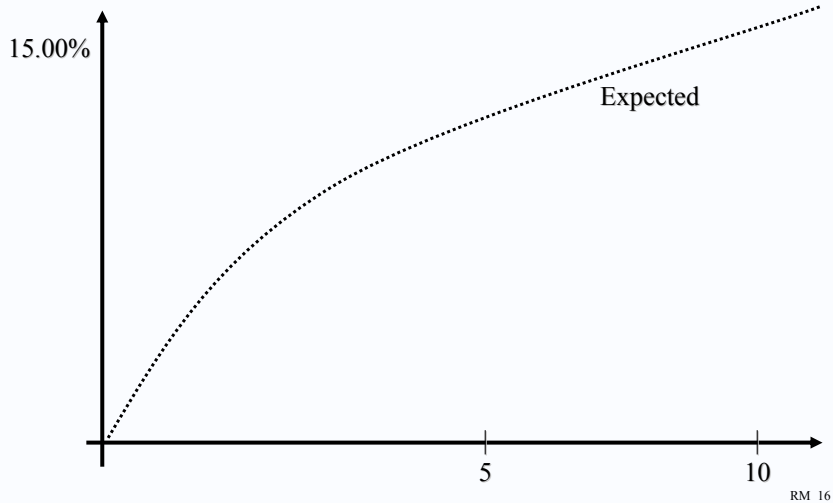
Exposure Through Time

- The amortization effect
 - » as time goes by, there are less outstanding exchanges of money outstanding, and the potential loss relative to the notional amount decline
- The diffusion (volatility) effect
 - » a function of “how far things can get”
 - » for interest rates, important to account for mean-reversion and lower volatility
 - » also, there is no exchange of principal

Combining the Effects: *interest rate swap*



Combining the Effects: *currency swap*



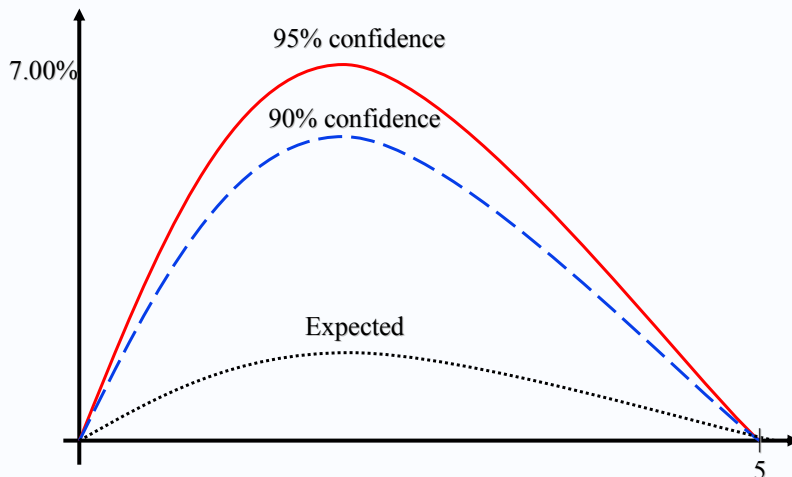
Average vs. Worst Case

- So far we discussed the expected path
- Regulators and management also ask: How much capital is needed under “adverse conditions” -- Maximum Exposure
- Loans: Maximum=Expected= Face
- IR Swaps: Maximum can be capped
Suppose short rates go to zero -- pay fix side loses X% every period
- FX Swaps: only prob statement

Analysis critically depends on the stochastic model for the underlying

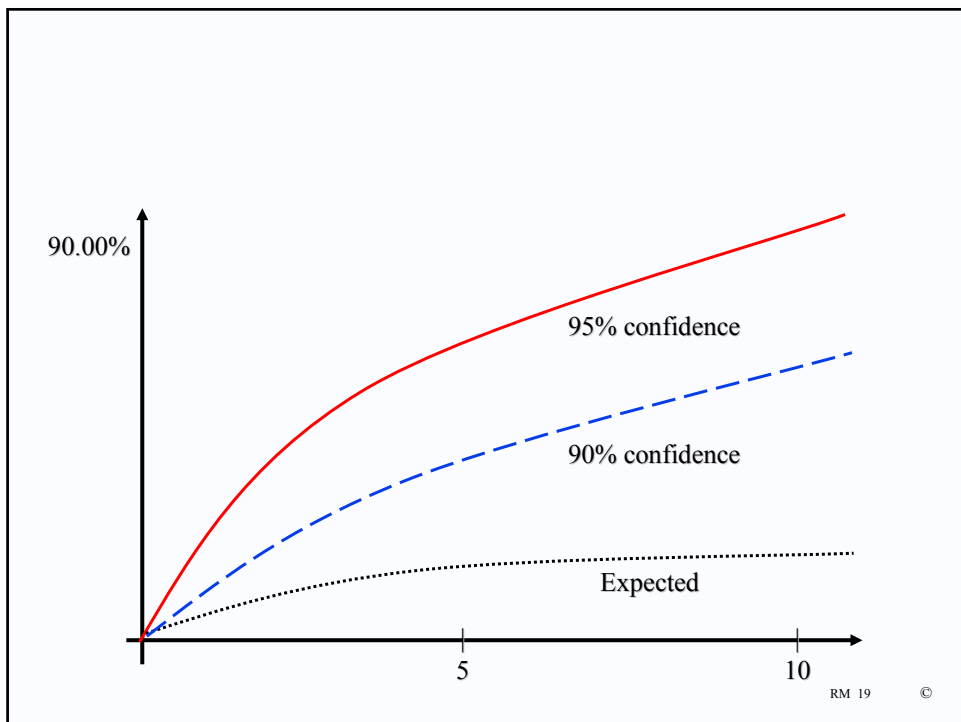
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RM 18

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Netting

- Addresses multiple contracts between two counterparties
- Key: defaulting counterparty cannot sell/reassign ITM contracts and “walk away” from OTM contracts
- Implications

w/o netting, loss is

$$\sum_i \text{Max} [0, V_i]$$

w/ netting

$$\text{Max} [0, \sum_i V_i]$$

...a much lower number

The Credit Risk of a Portfolio of Derivatives

- Exposure to a major counterparty should account for *netting*
example

<i>pay LIBOR</i>	<i>receive 7% on \$100MM</i>
<i>pay 8%</i>	<i>receive 7.5% on \$90MM</i>
- Net exposure is much smaller than the sum of replacement costs
- Netting can be generalized (in a portfolio sense)
 - » Layer 1: correlation of FX, Diff, IR swaps
 - » Layer2: correlation of def prob across counterparties