

# **CDS Spreads, Volatility Skews, and the Assessment of Credit Quality**

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# Background: Two Studies

- “The relationship between credit default swap spreads, bond yields, and credit rating announcements,” Hull, Predescu, and White
- “Merton’s model, credit risk, and volatility skews,” Hull, Nelken, and White

Both can be downloaded from my web site:

[www.rotman.utoronto.ca/~hull](http://www.rotman.utoronto.ca/~hull)

# CDS Data

- Provided by GFI, a major broker of credit default swaps
- Each day bid and offer quotes are recorded on a variety of names for CDSs
- Number of quotations has risen from 4,759 per year in 1998 to over 125,000 per year in 2002
- 5-year term has become the most common (and now accounts for 85% of trades)

# Calculation of Observations

- When there are both bids and offers for a 5-year CDS with a particular maturity on a particular name on a particular day and they satisfy a condition that “maxbid” and “minoffer” are reasonably close together we calculate an “observation” for the name on the day as

$$0.5*(\text{maxbid}+\text{minoffer})$$

# Main Questions Asked in First Study

- To what extent do 5-year CDS spreads anticipate/follow rating events?
- Are companies with relatively high (low) 5-year CDS spreads more likely to be downgraded (upgraded)?

# **The Moody's Announcements that We Consider**

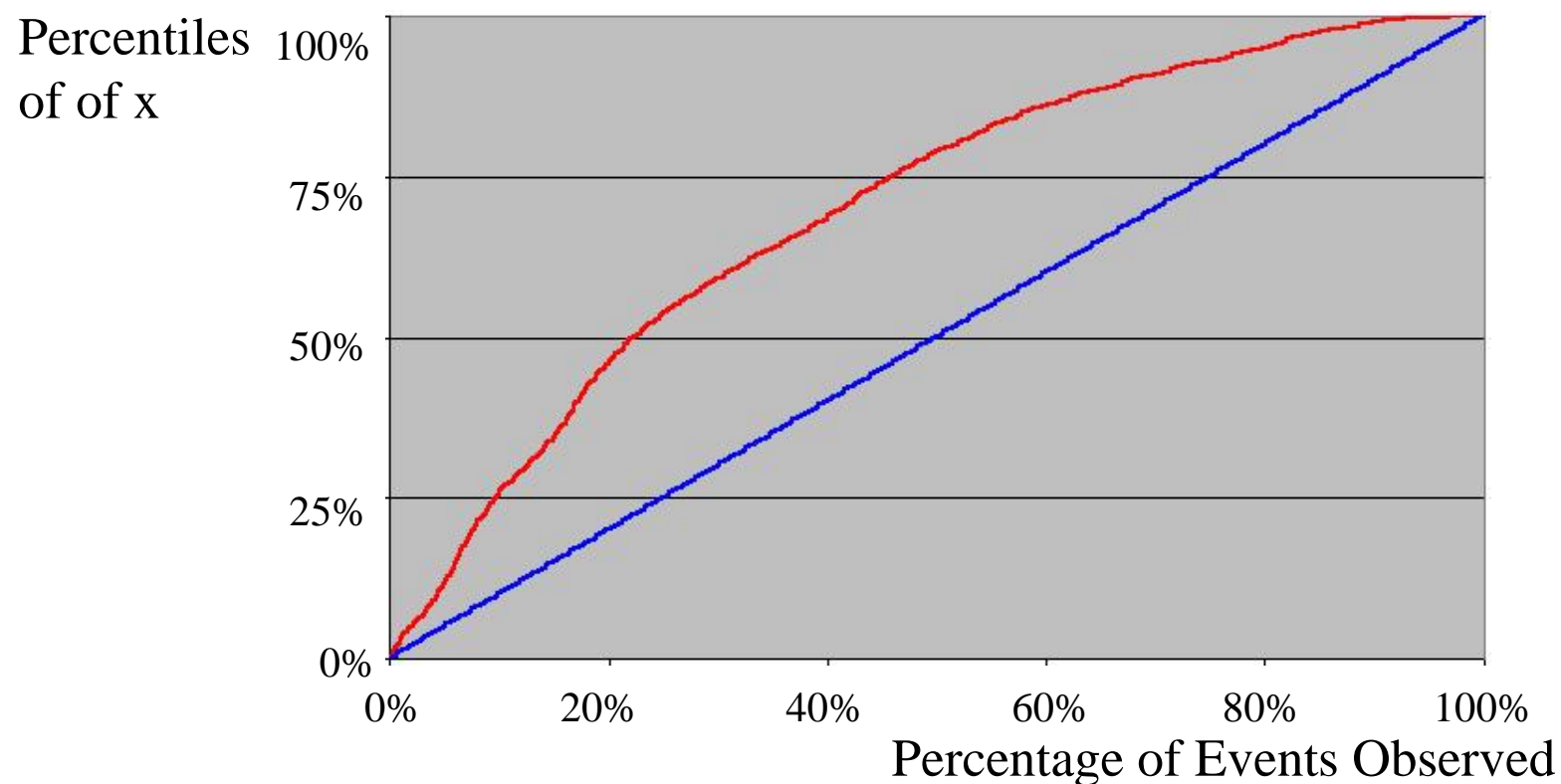
- Downgrades/upgrades
- Review/WatchList for upgrade or downgrade
- Outlook Report: positive, negative

# Event Study: Mean Change in Adjusted CDS Spread (bps) Around an Event

	No. of Events	Time Interval				
		[-90,-61]	[-60,-31]	[-30,-1]	[-1,1]	[1,10}
Downgrade	197	23.01**	34.90**	34.10**	5.40**	10.01**
Review for Downgrade	162	14.27**	5.05	23.44**	11.79**	6.41*
Negative Outlook	77	6.23*	9.17**	16.71**	2.42*	7.64

# Is variable $x$ a good predictor of the probability of an event?

## Construction of a CAP curve



# Percentage of Rating Events that Occur when the Adjusted Spread Change is above 100- $p$ Percentile

	$p = 50$	$p = 25$	$p = 10$
Downgrade	70.1**	50.6**	33.3**
Review for Downgrade	66.7**	41.9**	22.6**
Negative Outlook	70.9**	54.5**	18.2*

# Percentage of Rating Events that Occur when the Adjusted Spread Level is above $100-p$ Percentile

	$p = 50$	$p = 25$	$p = 10$
Downgrade	76.2**	51.5**	33.7**
Review for Downgrade	69.9**	43.7**	28.2**
Negative Outlook	66.1**	46.8**	12.9

# Conclusions from First Study

- We found no evidence that upgrades are anticipated or affect CDS spreads
- Downgrades appear to be anticipated and exhibit large spread increases on average before the event
- Negative reviews and outlook announcements are anticipated, but less strongly than downgrades. The spread increase before the event is smaller than for downgrades

# Second Study

- Start with Merton's model
- This is the model used by many researchers including Moody's KMV
- Assumes that all debt is due at a certain time  $T$  in the future
- If the value of the assets is greater than the debt's face value at time  $T$ , the debt is repaid; otherwise the company defaults

# The Moody's KMV Approach

- Estimate the face value of the debt, the value of the equity, and the volatility of the equity
- Use these to estimate the value of the assets and the volatility of the assets
- Use these to estimate the risk-neutral probability of default and a credit spread on debt

# The Approach continued

- The probabilities of default obtained in this way are low
- However the rank ordering of the probabilities of default appears to be roughly correct
- It is therefore possible to devise a monotonic function mapping the probabilities of default to either risk-neutral or real-world probabilities of default

# An Alternative

- Look at equity volatility skews in conjunction with Merton's model
- Under Merton's model an option on a stock is an option on an option on the company's assets and can be evaluated using a result from Geske

# Definitions

- Suppose that  $D$  is the face value of the debt,  $T$  is the time when the debt is to be repaid,  $r$  as the risk-free rate,  $A_0$  is the value of the assets today,  $q$  as the dividend yield, and  $\sigma$  as the volatility of the assets
- Define a leverage measure for the company as  $L = (De^{-rT})/(A_0e^{-qT})$
- Credit spread depends on  $L$ ,  $\sigma$ , and  $T$

# The Model

- Define the 50 delta and 25 delta volatilities as  $\sigma_{50}$  and  $\sigma_{25}$  respectively.
- We can determine  $L$  and  $\sigma$  from  $\sigma_{50}$  and  $\sigma_{25}$  and  $T$
- We can then determine the probability of default and credit spread from  $L$  and  $\sigma$

# Implied Spread vs CDS spread Firm-by-Firm across Time

No. of obs per firm	$\geq 10$	$\geq 30$
No. of Firms	149	86
Avg Rank Correlation	0.47	0.56
Median Rank correlation	0.61	0.69

# Implied Spread vs CDS Day-by-day across Firms

Avg Rank Correlation	0.40
Median Rank Correlation	0.42
First Quartile Rank Correlation	0.31
Corr >0/Corr<0	220/2

# Comparison with Traditional Approach Based on Equity Prices and Historical Volatility Estimates

- The firm-by-firm rank correlation for firms with 30 or more observations has a mean of 0.45 and a median of 0.57
- The day-by-day rank correlations had a mean of 0.35 and a median of 0.35

# Conclusions from Second Study

- Volatility skews when used in conjunction with Merton's model explain observed CDS spreads well
- The use of volatility skews avoids the need to estimate the level of the company's debt.
- It is necessary to estimate the maturity of the debt, but we find the rank ordering of implied CDS spreads fairly insensitive to this
- Volatility skews are potentially useful as predictors of the probabilities of default and rating changes