



CREDIT RISK


- Credit ratings
- Credit risk models
- Bond factor models



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CREDIT RISK


- What is credit risk?
 - The possibility that lenders or investors not getting money back.
- Two components of expected losses
 - Probability of Default
 - Loss Severity = 1-Recovery Rate
 - Expected Loss = P(default) x (1-Recovery Rate)
 - AAA -> C or D
 - Analysis will shift focus from P(default) to Loss Severity.

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DEFAULT

- What is default?
 - Violation of Bonds' Indenture: Payment Schedule & Covenants
 - Financial (Payment Schedule) vs Technical Default (Covenants)
- Consequences of default
 - Re-negotiate
 - Investors agree to change the contract
 - File for bankruptcy protection
 - Common pool problem and bankruptcy protection
 - Liquidation (Chapter 7) vs. reorganization (Chapter 11)

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LOSS SEVERITY/RECOVERY RATE

Security/collateral and seniority

Typical seniority ranking:

- 1. First lien loan – senior secured
- 2. Second lien loan – secured
- 3. Senior unsecured
- 4. Senior subordinated
- 5. Subordinated
- 6. Junior subordinated

Violations of absolute priority rule

Seniority ranking	Average recovery rate (1987-2010)
Senior secured	63.5%
Senior unsecured	49.2%
Senior subordinated	29.4%
Subordinated	29.3%
Junior subordinated	18.4%

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CREDIT RATINGS

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CREDIT RATINGS

- What is a credit rating?
 - Issue versus issuer ratings
- Provided by credit rating agencies
 - S&P, Fitch, Moody
- Rating process
 - Initial rating process
 - Surveillance process
- Who pays for ratings? Issuer Pay and Subscription Model
 - Rating shopping
 - Rating catering

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CREDIT RATING SCALES

Moody's	S & P / Fitch	Interpretation
Aaa	AAA	Highest quality
Aa1	AA+	High quality
Aa2	AA	
Aa3	AA-	
A1	A+	Strong Payment Capacity
A2	A	
A3	A-	
Baa1	BBB+	Adequate Payment Capacity
Baa2	BBB	
Baa3	BBB-	
Ba1	BB+	Likely to fulfil obligations: ongoing uncertainty
Ba2	BB	
Ba3	BB-	
B1	B+	High risk obligations
B2	B	
B3	B-	
Caa	CCC+	Current Vulnerability to default
	CCC	
	CCC-	

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CREDIT RATINGS AND DEFAULT PROBABILITY

	AAA	AA	A	BBB	BB	B	CCC/C
Average default probability (S&P, 1991-2010)	0.00	0.03	0.08	0.23	0.87	5.00	25.91

- The relationship between credit ratings and default probability can also be used to price rated bonds
 - Adjusted for risk, the expected return on risky and risk-free securities should be the same

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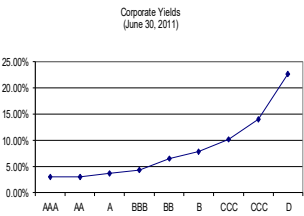
USING CREDIT RATING INFORMATION: EXAMPLE 1A

Consider a 1-year zero-coupon bond that has a BBB rating. Assume that this bond is senior secured (historical recovery rate = 63.5%). The yield on a 1-year zero-coupon Treasury bond is 6%. What should be the yield on this BBB-rated bond? [Assume periodicity of 1]

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CREDIT RISK STRUCTURE OF INTEREST RATES

- Relationship between credit risk and yields on bonds of varying degrees of credit risk, holding maturity constant
- Typically, use ratings as a measure of risk



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YIELD SPREADS

- For a Treasury bond:
 $\text{Yield} = \text{Base interest rate} + \text{Maturity premium}$
- For a corporate bond:
 $\text{Yield} = \text{Base interest rate} + \text{Maturity premium} + \text{Credit risk premium} + \text{Liquidity premium}$
- Yield spread = Yield on a corporate – Yield on a same-maturity Treasury bond
 $= \text{Credit risk premium} + \text{Liquidity premium}$

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YIELD SPREADS: EXAMPLE 1B

Consider the 1-year zero-coupon bond with a BBB rating, whose yield we calculated in Example 1A. What is the yield spread on this bond? Assume that the following are yields on Treasury STRIPS of different maturity:

Maturity	YTM
1	6%
2	6.2%
3	6.6%

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CREDIT RISK MODELS

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ASSESSING CREDIT RISK

- Qualitative models
- Credit-scoring models
- Newer models

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QUALITATIVE MODELS

- The four Cs of credit analysis
 - Capacity
 - Collateral
 - Covenants
 - Character

- Capacity
 - Industry fundamentals
 - Issuer fundamentals
 - Competitive position
 - Operating history
 - Ratio analysis
 - Profitability and cash flow
 - Leverage
 - Coverage
 - Liquidity

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CREDIT SCORING MODELS

- Altman's linear discriminant model (Z-score model)
 - Provides a score (Z-score) that allows you to classify firms into low and high risk
 - $Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$
 - X_1 = Working capital/total assets.
 - X_2 = Retained earnings/total assets.
 - X_3 = EBIT/total assets.
 - X_4 = Market value equity/ book value LT debt.
 - X_5 = Sales/total assets.
 - Low Z implies high default probability (threshold of 1.81)
 - Between 1.81 and 2.99 is the "gray area"

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ALTMAN'S Z-SCORE MODEL: EXAMPLE 2

Consider a firm with the following characteristics:
 X_1 (Working capital/total assets)=.01
 X_2 (Retained earnings/total assets)=.1
 X_3 (EBIT/total assets)= -0.25
 X_4 (Market value equity/ book value LT debt)=.4
 X_5 (Sales/total assets)=1

Calculate and interpret the Z score for this firm.

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NEWER MODELS

- Term structure based methods
 - Adjusted for risk, the expected return on risky and risk-free securities should be the same
 - Technically, risk-neutral valuation
 - You can calculate the default probability implied by the prices of similar bonds and use it to price this bond
 - What are similar bonds?

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**TERM STRUCTURE BASED METHODS:
EXAMPLE 3 (NO RECOVERY)**

Consider a firm whose 1-year zero-coupon bonds currently yield 10%. The yield on 1-year zero-coupon Treasury bonds is 8%. What is this firm's implied probability of default if the recovery rate expected by bondholders is zero?

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**TERM STRUCTURE BASED METHODS:
EXAMPLE 4 (CERTAIN RECOVERY RATE)**

Consider a firm whose 1-year zero-coupon bonds currently yield 10%. The yield on 1-year zero-coupon Treasury bonds is 8%. What is this firm's implied probability of default if bondholders expect to recover \$.60 on the dollar if the firm defaults? Assume periodicity of 1.

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**TERM STRUCTURE BASED METHODS:
EXAMPLE 5 (UNCERTAIN RECOVERY RATE)**

Consider a firm whose 1-year zero-coupon bonds currently yield 10%. The yield on 1-year zero-coupon Treasury bonds is 8%. What is this firm's implied probability of default if when the firm defaults bondholders expect to recover \$.60 on the dollar with probability 1/3 and \$.40 on the dollar with probability 2/3?

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TERM STRUCTURE BASED METHODS:
EXAMPLE 6 (MULTIPERIOD CASE)

Consider a firm whose 1-year zero-coupon bonds currently yield 10%, and 2-year bonds currently yield 12%. The yields on 1-year and 2-year zero-coupon Treasury bonds (i.e. the 1-year and 2-year spot rates) are 8% and 9% respectively. What is this firm's implied cumulative probability of default if bondholders do not expect to recover anything in the case of default?

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BOND FACTOR MODELS

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FACTOR MODELS

- What are factor models?
 - Modern portfolio theory (Markowitz)
 - Higher expected returns only possible when taking on more risk
 - CAPM (Sharpe)
 - APT (Ross)
 - $E(r_i) - r_f = \beta_{i1} [E(f_1) - r_f] + \dots + \beta_{ik} [E(f_k) - r_f]$
- Stock factor models
 - What are the most common/standard factors?
- Bond factor models
 - What are the most common/standard factors?

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BOND FACTOR MODELS: EXAMPLE 7

A bond has an expected return of 17.6%, sensitivity to the term factor of 1.45 and to the default factor of 0.86. The current term risk premium is 3.2%. The risk free rate of return is 5%. What is the default risk premium if no arbitrage opportunities exist?

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