CREDIT RISK

Credit Risk
- The basic credit risk equation is
  
  \[ \text{Credit risk} = \text{Exposure size} \times \text{Probability of default} \times \text{Loss given default} \]

  Each of these terms is difficult to measure
  Each of these terms changes over time
    Sometimes quickly

Recovery Rates
- Loss given default is
  
  \[ 1 - \text{Recovery Rate} \]
Recovery Rates

- As a Percentage of Face Value, 1982-2003

<table>
<thead>
<tr>
<th>Class of Security</th>
<th>Average Recovery Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Secured</td>
<td>51.6%</td>
</tr>
<tr>
<td>Senior Unsecured</td>
<td>36.1</td>
</tr>
<tr>
<td>Senior Subordinated</td>
<td>32.5</td>
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<tr>
<td>Subordinated</td>
<td>31.1</td>
</tr>
<tr>
<td>Junior Subordinated</td>
<td>24.5</td>
</tr>
</tbody>
</table>

Recovery Rates

- These are US averages
- There is wide variation in recovery rates
  - Time period
  - Industry
  - Reason for default
- This suggests estimates of LGD = 50-75%
Exposure

- The potential exposure is the amount of credit outstanding when the credit event occurs.

- For a "plain vanilla" bond, the exposure is the face value of the bond.

- If the bond has a sinking fund or other repayment clauses (e.g., call provision), the calculation of exposure is more complex.

Exposure

- The size of the outstanding credit allowance or AR will vary depending on:
  - Customer's buying cycle
  - Customer's working capital cycle
  - Changes in your credit policy

- Exposure calculations can be complicated by changes in market values and/or exchange rates.

Exposure

- To simplify, many companies measure exposure as:
  - Maximum allowable credit limit
  - Maximum granted credit limit

- If there are no credit limits, exposure can be measured as the peak credit usage:
  - Why are there no credit limits?
Default risk

- There are well established methods for analyzing default risk
  - All are sensitive to the time period examined

- Credit events tend to be caused by sudden/unforeseen changes in circumstances
  - These are difficult to capture with quantitative methods
Default Risk - “Five Cs”

- The most basic approach looks at the “Five Cs”
  - Capacity
    - Ability to repay obligations out of cash flows
  - Capital
    - Cash on hand
  - Collateral
    - Quality of the company’s assets that could be sold
  - Conditions
    - Business conditions for industry and company
  - Character
    - Reputation/integrity of management

“Five Cs”

- Widely used measures of capacity
  - Current ratio = Current assets/current liabilities
  - Quick ratio = (CA – inventory)/current liabilities
- Can also look at
  - Burn rate = Annual expenses/365
  - Days cash on hand = Available cash/burn rate
- For longer term financial conditions
  - Debt ratio = TL/TA
  - Debt ratio = Long term debt/TA

“Five Cs”

- You can also look at coverage ratios
  - Interest coverage = EBIT/Interest expense
  - Debt service coverage = NOI/total debt service
  - DSC ratio is cash flow available to meet interest and principal payments, including sinking fund provisions
  - Lease payment may also be included in debt service
"Five Cs"

- Ratios are based on financial statements
  - Financial statements are backward looking
- You need to examine any trends in the ratios
- You need to compare the ratios to peers/norms

Time to Pay

- Changes in the time it takes a creditor to pay is an important early warning sign
  - May be a change in working capital policy
  - May be a sign of cash flow problems
    - Creditor may be stretching out payments to conserve cash

Credit Ratings

- Credit ratings give information about default risk
  - Look a financial strength ratings, not bond ratings
- Credit ratings are quick and easy to use

- Transitions tend to occur slowly
  - It is important to watch for downgrades
  - Easier to find for large companies than small
  - Commercially available for small companies
Credit Ratings
One Year Transitions, Moody's 1970-2006

<table>
<thead>
<tr>
<th>Year</th>
<th>Aaa</th>
<th>Aa</th>
<th>A</th>
<th>Ba</th>
<th>B</th>
<th>Caa</th>
<th>Cc</th>
<th>Default</th>
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<tr>
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<tr>
<td>1982</td>
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<td>0.32</td>
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<tr>
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<td>1980</td>
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<td>0.39</td>
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<td>4.64</td>
<td>10.47</td>
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<td>2.70</td>
<td>11.07</td>
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</tbody>
</table>

Default Risk

- Market Based Approaches
- There are three market based approaches
  - YTM Approach
  - CDS Approach
  - "Merton Model"

- The advantage of market based approaches is that they are forward looking

YTM Approach

- YTM approach is based on the credit spread
  - YTM – Treasury YTM

- YTM is affected by bond features such as call, conversion
- Can use “option adjusted spread”
  - This accounts for the bond features and gives the credit spread "as if" it is a plain vanilla bond
CDS Approach

- CDSs are essentially bond insurance
  - Protection buyer pays a fee (CDS spread) to protection seller
  - Protection seller pays buyer if there is a “credit event”
    - Downgrade
    - Default
    - Bankruptcy

- Fee = CDS spread x Notional value
- Payment = Loss given default x Notional value

Anyone can buy a CDS on a traded bond
- Can hedge credit risk if you own the bond
- Can speculate in issuers credit risk if don’t

Merton Model

- Recall that equity is a call option on the firm’s assets with exercise price equal to the face value of debt

- The Black-Scholes formula for a European call is
  \[ C = S N(d_1) - Ke^{-rt}N(d_2) \]
  - For a call, \( N(d_1) \) is the prob the option finishes in the money (and is exercised)
  - \( N(-d_2) = 1 - N(d_2) \) is the prob the option finished out of the money (and is not exercised)
Merton Model

- Step 1: Calculate value of equity
  - Replace \( S \) with value of assets, \( K \) with face value of debt at maturity
  - Estimate \( \sigma_A \) = volatility of assets
  - Compute value of equity from Black-Scholes

Merton Model

- Step 2: Calculate probability of default
  - Replace risk-free rate with growth rate of firm’s assets
  - Compute PD = \( 1 - N(d_2^*) \)
  - Compute “distance to default” = \( \frac{(\text{asset value} - \text{default threshold})}{\sigma} \)


Merton Model – Simplified Version

- Under reasonable assumptions the Merton Model can be simplified
  - Let \( L = D/A \) be the firm’s leverage
  - Let \( \sigma_E \) be the volatility of equity
  - Then the distance to default can be estimated as \( DD = \ln(L)/(L - 1) \sigma_E \)
Statistical Methods

- The basic idea is to develop a score to rank creditworthiness
  - Best known example is FICO score
  - Development of scoring models require very large data sets to be statistically valid
  - Scoring models can provide a good description of credit risk for a large portfolio of credits
    - They do not capture the unique characteristics of each individual (e.g., "character")

Altman Z-Score

- Altman’s Z-score is a well known scoring model
  \[ Z = 1.2F1 + 1.4F2 + 3.3F3 + 0.6F4 + 0.999F5 \]
  - \( F1 = \frac{\text{working capital}}{\text{TA}} \)
  - \( F2 = \frac{\text{RE/TA}}{\text{TA}} \)
  - \( F3 = \frac{\text{EBIT/TA}}{\text{TA}} \)
  - \( F4 = \frac{\text{MVEquity/BookDebt}}{\text{TA}} \)
  - \( F5 = \frac{\text{Sales/TA}}{\text{TA}} \)
  - \( Z < 1.80 \Rightarrow \text{financial distress} \)
  - \( Z > 2.99 \Rightarrow \text{safe credit risk} \)

Credit Risk Mitigation

- There are three types of credit risk
  1. Customer credit risk
  2. Sovereign risk
  3. Funding risk (your credit risk)
### Customer Credit Risk

- Trade credit is very widely used
- Customer credit risk can be mitigated by policies
  - Credit limits
  - Repayment terms
    - Including interest rates and time to repay
  - Collateral requirements

### Customer Credit Risk

- Marketing/Sales department will typically argue for more liberal credit terms
  - More liberal terms
    - Increase credit exposure
    - Can lead to adverse selection
    - May attract less creditworthy customers
    - Requires additional financing
  - These costs need to be balanced against the benefit on increases sales

### Customer Credit Risk

- You need to have a policy, determined in advance, on how you will respond to
  - Late payments
  - Non-payment
- Will you
  - Call the customer
  - Cash sales only
  - Hire collection agency
  - Take legal action
Customer Credit Risk

- If the company has enough AR, it may be able to securitize them
- Smaller companies can sell their AR to a factoring company
  - Without recourse – sale is final
  - Without recourse – factoring co. can request pay for bad AR

Customer Credit Risk

- Factoring co.s can provide financing and possible way to reduce credit risk
- Need to analyze terms carefully
  - Discounts can be deep

Sovereign Credit Risk

- This is the risk that a government (esp. a foreign gov’t) will change regulations/laws in a way that prevents an obligation from being fully collectible
  - E.g., capital controls
- This is a part of the political risk of doing business internationally
Sovereign Credit Risk

- For large foreign investments, you may want to finance the investment through a host country bank
  - If you are expropriated, don’t repay the bank

- For foreign customers, you may want to require a letter of credit
  - LOC (typically issued by a bank) essentially guarantees the seller will be paid for the goods delivered to the buyer
  - Disadvantage is the LOC increases costs

Funding Risk

- Funding risk is the risk that a company cannot obtain sufficient financing
  - In a timely fashion
  - On reasonable terms
  - This is a problem of managing the credit risk that you present to others
  - Funding risk depends on
    - Your company’s financial condition
    - Industry conditions
    - Credit market conditions

Funding Risk

- Funding risk is potentially a bigger problem the more that you rely on rolling over short-term debt
  - E.g., Lehman Bros.
Funding Risk

- To manage funding risk you should
  - Maintain adequate cash reserves
  - Don’t rely on “hot money”
  - Maintain a conservative capital structure
  - Develop relationships with multiple lenders
    - Diversify your sources of financing
    - Diversify the types of financing

Funding Risk

- Maintaining financial flexibility can offer strategic advantages
  - Can offer better credit terms to customers
  - Can finance strategic opportunities
    - Especially in adverse economic/industry conditions