Setting Risk Tolerance Levels
Session CS 2B

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Overview of Common ERM Framework

- Step 1: Estimate Profit/Loss Distributions by Risk Source, Business Unit, etc.
- Step 2: Aggregate P/L Distributions into Firmwide P/L Distribution
- Step 3: Estimate Economic Capital Based on Firmwide Capital Standard
    - Linked Directly to Risk Tolerance
    - Often Based on Target Probability of Default
    - Often Tied to Target Credit Rating
    - e.g. “Economic Capital is the amount needed to ensure a probability of default less than the probability of default for AA-rated bonds.”
- Step 4: Attribute Economic Capital to Each Risk Source or Business Unit
- Step 5: Calculate Selected Metrics
    - Return on Risk Adjusted Capital
    - Economic Value Added

How Do Firms Establish the Firmwide Capital Standard in Step 3?

- Alternative Methods
  - Set Minimum Required Capital to Achieve Long Term Business Plan
  - Set Minimum Required Capital to Maintain Target Credit Rating
  - Determine Capital Required (now) to Ensure Target Probability of Default Over Selected Horizon
- Target Probability of Default
  - Could Be Subjectively Set
  - Could Be Based on Management's Risk Tolerance
  - Often Tied to Corporate Bond Default Probabilities at Selected Credit Rating Level
- But this raises important questions:
  - What are the Bond Default Probabilities by rating?
  - What is a reliable source for these probabilities?
  - How stable are these measures of default probability?
  - What methodology choices exist?

Bond Default Probabilities by Rating – Alternative Approaches

- Historical Default Probabilities
  - Altman's Studies
  - Moody's Historical Default Statistics
  - S&P's Historical Default Statistics
- Inferred from Current Market Prices of Corporate Bonds
- Merton Model (Moody's/KMV)
  - Uses Equity Prices to Estimate Net Asset Volatility
  - Assumes Specific Default Point for Assets
  - Estimates Probability of Default Based on Distributional Assumptions and These Parameters
- Other Methods
  - Econometric Models
  - Altman's Zeta Model

I'll focus the next several slides on the Historical Default Probabilities

Historical Default Probabilities

- Altman's Default Studies
  - Forms cohorts by *original r*ating at issuance
  - Separates the default probability from the default severity (loss given default)
  - Estimates annual default probabilities *n*-years from issuance
- Moody's and S&P Studies
  - Form cohorts based on rating at the *beginning of the year* and separate default probability from default severity
  - Moody's and S&P use slightly different definitions of default
    - See Next Slide

Moody's and S&P Definitions of Default

Moody's Default Definition	**S&P's Default Definition**
Missed or delayed disbursement of interest and/or principal, **including delayed payments made within a grace period**.	First occurrence of a payment default on any financial obligation. **An exception occurs when an interest payment missed on the due date is made within the grace period.**
Issuer files for bankruptcy (Chapter 11, or less frequently Chapter 7, in the US) or legal receivership occurs.	
Distressed exchange occurs where: (i) the issuer offers bondholders a new security or package of securities that amount to a diminished financial obligation (such as preferred or common stock, or debt with a lower coupon or par amount), or (ii) **the exchange had the apparent purpose of helping the borrower avoid default.**	Distressed exchanges are considered defaults whenever the debt holders are coerced into accepting substitute instruments with lower coupons, longer maturities, or any other diminished financial terms.
Source: Moody's *Default & Recovery Rates of Corporate Bond Issuers,* Jan 2004	Source: Standard & Poor's *Rating Performance 2002*

Bond Default Probabilities by Rating

Estimated Default Probabilities
By Rating Class

S&P Rating	Moody's Equivalent	Default Probability (Subsequent year)	Coverage Level
AAA	Aaa	0.01%	99.99%
AA	Aa3/A1	0.03%	99.97%
A	A2/A3	0.11%	99.89%
BBB	Baa2	0.30%	99.70%
BB	Ba1/Ba2	0.81%	99.19%
B	Ba3/B1	2.21%	97.79%
CCC	B2/B3	6.00%	94.00%
CC	B3/Caa	11.68%	88.32%
C	Caa/Ca	16.29%	83.71%

Source: James, *RAROC Based Capital Budgeting and Performance Evaluation: A Case Study of Bank Capital Allocation,* 1996, Wharton Working Paper 96-40. Author cited Bank of America as his source.

Stability of the Default Probabilities

- The following tables show reported default probabilities from S&P and Moody's reports for selected years.
- Notice the AA/Aa default probabilities have ranged from 0.00% to 0.03%.

		Default % - Data 1981 through			
		1997	2000	2002	2003
S&P	AAA	0.00	0.00	0.00	0.00
	AA	0.00	0.01	0.01	0.01
	A	0.05	0.04	0.05	0.05

		Default % - Data 1970 through				
		1996	1999	2001	2002	2003
Moody's	Aaa	0.00	0.00	0.00	0.00	0.00
	Aa	0.03	0.03	0.02	0.02	0.02
	A	0.01	0.01	0.02	0.02	0.02

- Notice that the 0.03% standard is difficult to justify.
- Whatever you use, it is likely to be a VERY small number.
  - How reliable are 99.97% or 99.99% Value at Risk estimates?
  - Is this difference significant?

Methodology Issues

- Treatment of Withdrawn Rating Category
  - Both S&P and Moody's statistics track bonds in which the ratings are withdrawn ("NR").
  - Most practitioners exclude the NR data from their default probability calculations, though S&P argues that this overstates the default probabilities.
- Single Year vs. Multi-Year Average
  - Some practitioners prefer to use longer term (5-year and 10-year) default statistics and then estimate an average *annual* default rate.
  - This approach can result in substantial variation in annual default probability estimates, as shown below:

Moody's 1970-2003 Aa Default Rates – 1, 5 and 10-Year Horizons

	1-Year	5-Year	10-Year
Aa Default Rate	0.02%	0.24%	0.68%
Annual Default Rate	0.02%	0.05%	0.07%

Methodology Issues (*continued)*

- Single Year vs. Multi-Year Default Probabilities
  - One-year horizons are common, but some practitioners use multi-year horizons
  - This requires multi-year default probabilities
  - Two Alternative Sources
    - Historical data from cohorts evaluated over multiple years
    - Annual rating transition matrices
- S&P Historical Multi-Year Default Probabilities

Cumulative Default Probabilities (%)

	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5	Yr. 6	Yr. 7	Yr. 8	Yr. 9	Yr. 10
AAA	0.00	0.00	0.04	0.07	0.12	0.21	0.31	0.49	0.56	0.63
AA	0.01	0.04	0.11	0.20	0.33	0.48	0.68	0.85	1.00	1.18
A	0.05	0.15	0.30	0.50	0.75	1.01	1.29	1.55	1.88	2.20
BBB	0.37	1.06	1.80	2.84	3.84	4.83	5.66	6.42	7.11	8.00
BB	1.45	4.38	7.98	11.39	14.45	17.64	20.23	22.51	24.88	26.72
B	6.59	15.03	22.46	28.47	33.02	36.91	40.44	43.73	45.93	48.30
CCC/C	34.14	44.07	50.54	55.65	61.35	63.93	64.94	65.58	68.78	71.46

Single Year vs. Multi-Year Default Probabilities (*continued)*

- Rating Transition Matrices
  - S&P and Moody's also publish **transition matrices** that show changes in ratings as well as defaults. For example:

Average One-Year Transition Probabilities, NR-Adjusted, 1981-2003

From/To	AAA	AA	A	BBB	BB	B	CCC/C	D
AAA	92.08	7.09	0.63	0.15	0.06	0.00	0.00	0.00
AA	0.62	90.83	7.76	0.59	0.06	0.10	0.02	0.01
A	0.05	2.09	91.37	5.79	0.44	0.16	0.04	0.05
BBB	0.03	0.21	4.10	89.38	4.82	0.86	0.24	0.37
BB	0.03	0.08	0.40	5.53	83.25	8.15	1.11	1.45
B	0.00	0.08	0.27	0.34	5.39	82.41	4.92	6.59
CCC/C	0.10	0.00	0.29	0.58	1.55	10.54	52.80	34.14

Source: S&P Rating Performance Report 2003

  - These matrices can be compounded for multiple periods to produce *n*-year default probabilities. For instance, the 5-year transition probabilities would be estimated as:

Estimated Five-Year Transition Probabilities (%)

From/To	AAA	AA	A	BBB	BB	B	CCC/C	D
AAA	66.54	25.03	6.53	1.40	0.34	0.12	0.02	0.04
AA	2.21	63.41	27.23	5.38	0.83	0.53	0.10	0.26
A	0.29	7.40	66.75	19.90	3.34	1.26	0.25	0.77
BBB	0.15	1.40	14.19	60.67	14.21	5.08	0.92	3.42
BB	0.12	0.48	2.99	16.18	44.39	20.63	3.07	12.15
B	0.04	0.32	1.25	3.10	13.55	42.69	6.13	32.91
CCC/C	0.17	0.13	0.80	1.70	4.36	13.16	5.56	74.12

Rating Transition Matrices (*continued)*

- Notice that the 5-year default probabilities implied by the transition matrices differ from the actual 5-year default probabilities in many instances:

	Implied	Historical
AAA	0.04	0.12
AA	0.26	0.33
A	0.77	0.75
BBB	3.42	3.84
BB	12.15	14.45
B	32.91	33.02
CCC/C	74.12	61.35

- Some authors suggest adjusting the transition matrix to better match the historical long-term default. See Ong, *Internal Credit Risk Models: Capital Allocation and Performance Measurement*.

Additional Considerations

- Link Between Credit Rating and Probability of Default
  - S&P's 2003 Rating Performance Report:

    "It is important to note that Standard & Poor's ratings do not imply a specific probability of default; however, Standard & Poor's historical default rates are frequently used to estimate these characteristics."
- When management decides to target a "AA Rating", do they mean they want their *current* rating to be AA, or do they mean they want a high degree of confidence that their rating will stay AA over some time horizon?
  - If it is the former, then the historical default probabilities might be useful.
  - If it is the latter, then they are not.

Summary

- Setting a Risk Tolerance, VaR Confidence Level or Target Default Probability is a critical element of ERM frameworks.
  - Practitioners are often uncomfortable with subjective values for this key input.
  - They want something objective that they can point to.
- Many practitioners rely on the .03% AA Default Probability as the target default rate assumption. This might be reasonable, but keep in mind the following:
  - There is no direct support for .03% based on historical default statistics
  - Statistics change slightly from year to year
  - Moody's and S&P historical data are not identical
  - Many methodology choices can impact the chosen estimate:
    - How to handle withdrawn ratings
    - Single year averages or implied annual probabilities from multi-year default statistics
    - Multi-year historical averages vs. multi-year transition matrices
- It is important to consider the difference between targeting a *current* default probability and ensuring a particular rating over some selected horizon.