



Understanding Risk I: The risk in bonds

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The risk in bonds

- If you buy a conventional bond, you are promised fixed payments (coupons) in the future and the face value of the bond at maturity.
- You face two risks while you hold the bond:
 - Interest rate risk, where changes in market interest rates affect the value of your fixed payments.
 - Default risk, where the entity that promised the fixed payments is unable to deliver.

1. Interest rate risk

- The coupons and face value are fixed at the time of issue for bonds, but the value of these coupons can vary over time, even if they are guaranteed.
- If interest rates change after a bond has been issued, the value of these guaranteed cash flows will change. Thus, if interest rates go up (down), the present value of the cash flows (the price of the bond) will go down (up).

A simple example: The price of 4%, 10-year coupon bond

Year	Promised CF	PV @2%	PV@3%	PV@4%	PV@5%	PV@6%
1	\$40.00	\$39.22	\$38.83	\$38.46	\$38.10	\$37.74
2	\$40.00	\$38.45	\$37.70	\$36.98	\$36.28	\$35.60
3	\$40.00	\$37.69	\$36.61	\$35.56	\$34.55	\$33.58
4	\$40.00	\$36.95	\$35.54	\$34.19	\$32.91	\$31.68
5	\$40.00	\$36.23	\$34.50	\$32.88	\$31.34	\$29.89
6	\$40.00	\$35.52	\$33.50	\$31.61	\$29.85	\$28.20
7	\$40.00	\$34.82	\$32.52	\$30.40	\$28.43	\$26.60
8	\$40.00	\$34.14	\$31.58	\$29.23	\$27.07	\$25.10
9	\$40.00	\$33.47	\$30.66	\$28.10	\$25.78	\$23.68
10	\$1,040.00	\$853.16	\$773.86	\$702.59	\$638.47	\$580.73
		\$1,179.65	\$1,085.30	\$1,000.00	\$922.78	\$852.80

Measuring Interest rate risk

- There are two factors that determine how exposed a bond is to interest rate risk.
 - The level of coupons on the bond: Higher coupon bonds are less exposed to interest rate risk than lower coupon bonds.
 - The maturity of the bond: Longer maturity bonds are more exposed to interest rate risk than shorter maturity bonds.
- The “duration” of a bond is a composite measure of interest rate risk that incorporates both the magnitude of the coupons and the maturity of the bond. The higher the duration of a bond, the more sensitive it is to interest rate movements.

Duration: Example

Year	Cash Flow	Present Value	PV*t
1	\$40.00	\$38.10	\$38.10
2	\$40.00	\$36.28	\$72.56
3	\$40.00	\$34.55	\$103.66
4	\$40.00	\$32.91	\$131.63
5	\$40.00	\$31.34	\$156.71
6	\$40.00	\$29.85	\$179.09
7	\$40.00	\$28.43	\$198.99
8	\$40.00	\$27.07	\$216.59
9	\$40.00	\$25.78	\$232.06
10	\$1,040.00	\$638.47	\$6,384.70
		\$922.78	\$7,714.08
Duration of Bond =		8.36	

2. Default Risk

- When you buy a bond, you are promised a fixed payment (the interest rate on the bond) by the entity issuing the bond. If there is risk that the entity will default:
 - The best case scenario for you is that you receive that fixed payment.
 - The worse case scenarios have a much wider range, with the worst case scenario being that you do not receive any of your promised cash flows.
- Since the potential for upside is limited and for downside is very large, we measure risk in bonds by looking at the downside or default risk.

Determinants of Default Risk

- *Capacity to generate cashflows from operations:* The larger the cashflows that you generate from operations, the lower your default risk should be.
- *Volatility in these cashflows:* The more predictable your cashflows are, the lower your default risk should be.
- *Fixed Commitments:* The larger your commitments (interest and principal payments), relative to your operating cashflows, the greater is your default risk.

Measuring Default Risk

- *Credit Risk Scores*: For as long as institutions and individuals have been lending money, they have been using both qualitative and quantitative factors to measure the credit risk of borrowers.
- *Bond Ratings*: Publicly traded companies that desire to access the bond market (where individual investors may lack the resources and the incentives to measure default risk on their own) have been rated by ratings agencies.

And charging for default risk

<i>Rating</i>	<i>1 year</i>	<i>5 year</i>	<i>10 year</i>	<i>30 year</i>
Aaa/AAA	0.04%	0.16%	0.41%	0.65%
Aa1/AA+	0.07%	0.35%	0.57%	0.84%
Aa2/AA	0.09%	0.53%	0.73%	1.03%
Aa3/AA-	0.12%	0.58%	0.78%	1.09%
A1/A+	0.15%	0.62%	0.82%	1.15%
A2/A	0.36%	0.77%	0.95%	1.23%
A3/A-	0.41%	1.04%	1.31%	1.74%
Baa1/BBB+	0.63%	1.28%	1.55%	1.99%
Baa2/BBB	0.81%	1.53%	1.84%	2.33%
Baa3/BBB-	1.29%	1.98%	2.28%	2.74%
Ba1/BB+	2.07%	2.78%	3.12%	3.56%
Ba2/BB	2.85%	3.58%	3.97%	4.39%
Ba3/BB-	3.63%	4.38%	4.81%	5.21%
B1/B+	4.41%	5.18%	5.65%	6.03%
B2/B	5.19%	5.98%	6.49%	6.85%
B3/B-	5.97%	6.78%	7.34%	7.68%
Caa/CCC+	6.75%	7.57%	8.18%	8.50%

Ratings and Financial Ratios

	<i>AAA</i>	<i>AA</i>	<i>A</i>	<i>BBB</i>	<i>BB</i>	<i>B</i>	<i>CCC</i>
EBIT interest cov. (x)	17.5	10.8	6.8	3.9	2.3	1.0	0.2
EBITDA interest cov.	21.8	14.6	9.6	6.1	3.8	2.0	1.4
Funds flow/total debt	105.8	55.8	46.1	30.5	19.2	9.4	5.8
Free oper. cash flow/total debt (%)	55.4	24.6	15.6	6.6	1.9	-4.5	-14.0
Return on capital (%)	28.2	22.9	19.9	14.0	11.7	7.2	0.5
Oper.income/sales (%)	29.2	21.3	18.3	15.3	15.4	11.2	13.6
Long-term debt/capital (%)	15.2	26.4	32.5	41.0	55.8	70.7	80.3
Total Debt/ Capital (%)	26.9	35.6	40.1	47.4	61.3	74.6	89.4
Number of firms	10	34	150	234	276	240	23

Estimating Synthetic Ratings

- The rating for a firm can be estimated using the financial characteristics of the firm. In its simplest form, the rating can be estimated from the interest coverage ratio

$$\text{Interest Coverage Ratio} = \text{EBIT} / \text{Interest Expenses}$$

- For a firm, which has earnings before interest and taxes of \$ 3,500 million and interest expenses of \$ 700 million

$$\text{Interest Coverage Ratio} = 3,500/700 = 5.00$$

- Based upon the relationship between interest coverage ratios and ratings, we would estimate a rating of A for the firm.

Interest Coverage Ratios, Ratings and Default Spreads

<i>Interest Coverage Ratio: Small market cap (<\$5 billion)</i>	<i>Interest Coverage Ratio: Large market cap (>US \$ 5 billion)</i>	<i>Rating</i>	<i>Typical Default</i>
> 12.5	>8.5	AAA	1.25%
9.50–12.50	6.5-8.5	AA	1.75%
7.50–9.50	5.5-6.5	A+	2.25%
6.00–7.50	4.25- 5.5	A	2.50%
4.50–6.00	3- 4.25	A-	3.00%
4.00-4.50	2.5-3.0	BBB	3.50%
3.50–4.00	2.25-2.5	BB+	4.25%
3.00–3.50	2.0-2.25	BB	5.00%
2.50–3.00	1.75-2.0	B+	6.00%
2.00–2.50	1.5-1.75	B	7.25%
1.50–2.00	1.25-1.5	B-	8.50%
1.25–1.50	0.8-1.25	CCC	10.00%
0.80–1.25	0.65-0.8	CC	12.00%
0.50–0.80	0.2-0.65	C	15.00%
< 0.65	<0.2	D	20.00%