UNIVERSITÉ LIBRE DE BRUXELLES

Advanced Corporate Finance

9. Long Term Debt

Objectives of the session

1. Understand the role of debt financing and the various elements involved
2. Analyze the value of bonds with embedded options
3. Analyze convertible bonds

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Bond Financing

- For the ones interested: Fabozzi (2010)
- Corporate bonds : usually classified by type of issuers (public utilities, transportations, banks and finance and industrials)
- Issuers promises to repay a specified % of par value on designated dates and to repay par at maturity. Most corporate bonds in the US pay coupons semi-annually (in Europe annually), in rare instances zero-coupon bonds have been issued.
- Failure to repay => legal default
- Corporate bonds : issued in the same way as equity (prospectus etc…)
- Often indenture: contract between the bond issuer and a trust company representing the bondholders' interests

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Bond Financing

- Two main possibilities
- Bearer bonds => the owner has the right on the bond coupons and principal
  - Historically very frequent
  - Useful when one wants to avoid external control
  - Extremely tiresome to retrieve the coupons
  - Lack of security
- Registered bonds => the issuer has a list with all holders of its bonds
  - The most frequent
  - Easier for the state to collect taxes

Different forms of debts

- **Main distinction between secured and unsecured debts => quite logically in view of the guarantees offered to the bondholders**
- **Unsecured debts**
- No specific asset pledged as collateral
  - Notes (short and medium term debts)
  - Debentures: Longer term debts (Most bonds are due in 20 to 30 years)
- **Secured debts**
- Assets are pledged as collateral
  - Mortgage bonds (the assets are real estate)
  - Asset-backed bonds (a given asset is assigned as collateral for example rolling stocks for railways)
- **Guaranteed debts**
  - Bonds guaranteed by a third-party

Different forms of debts

- **On top of the existence or not of a collateral, seniority also plays an important role**
- Since many debentures may be outstanding, knowing who has priority in case of default is crucial
- =>Often clauses restricting the company's rights in terms of future issues
- Very often request that new issues be **subordinated** to the previous one
- In case of defaults subordinated bonds get repaid once all the more senior debts have been cleared

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Debts…

- May either be traded on the bond market
  - Domestic bonds. Example: Solvay issuing a bond in € in Belgium
  - Foreign bonds (Yankee bonds, Samurai Bonds, Bulldog bonds). Example: Solvay issuing a bond in $ in the USA
  - Eurobonds. Bonds issued in a currency different from the currency of the country where they are traded. Example: Solvay issuing a bond in $ in Thailand
  - Global bonds. Sold in several countries at the same time

- Important decision and many implications

Debts…

- … or be held Privately
- Term Loans => bank loan with a specific term, possibility to have it issued by a syndicate
- Line of credit : Credit commitment for a specific time-period or to some limit
- Private Placement => not traded on a market but sold to a small group of investors

Special Features

- **Bonds may have call and refund provisions**
- Sometimes the issuer wishes to be able to retire the issue before its maturity (if they anticipate a decline in interest rates)
- Distinction between noncallable and nonrefundable bonds => one cannot be called before maturity, the other cannot be callable if the issuer needs to issue new debt
- Noncallable isssues => bullet bonds

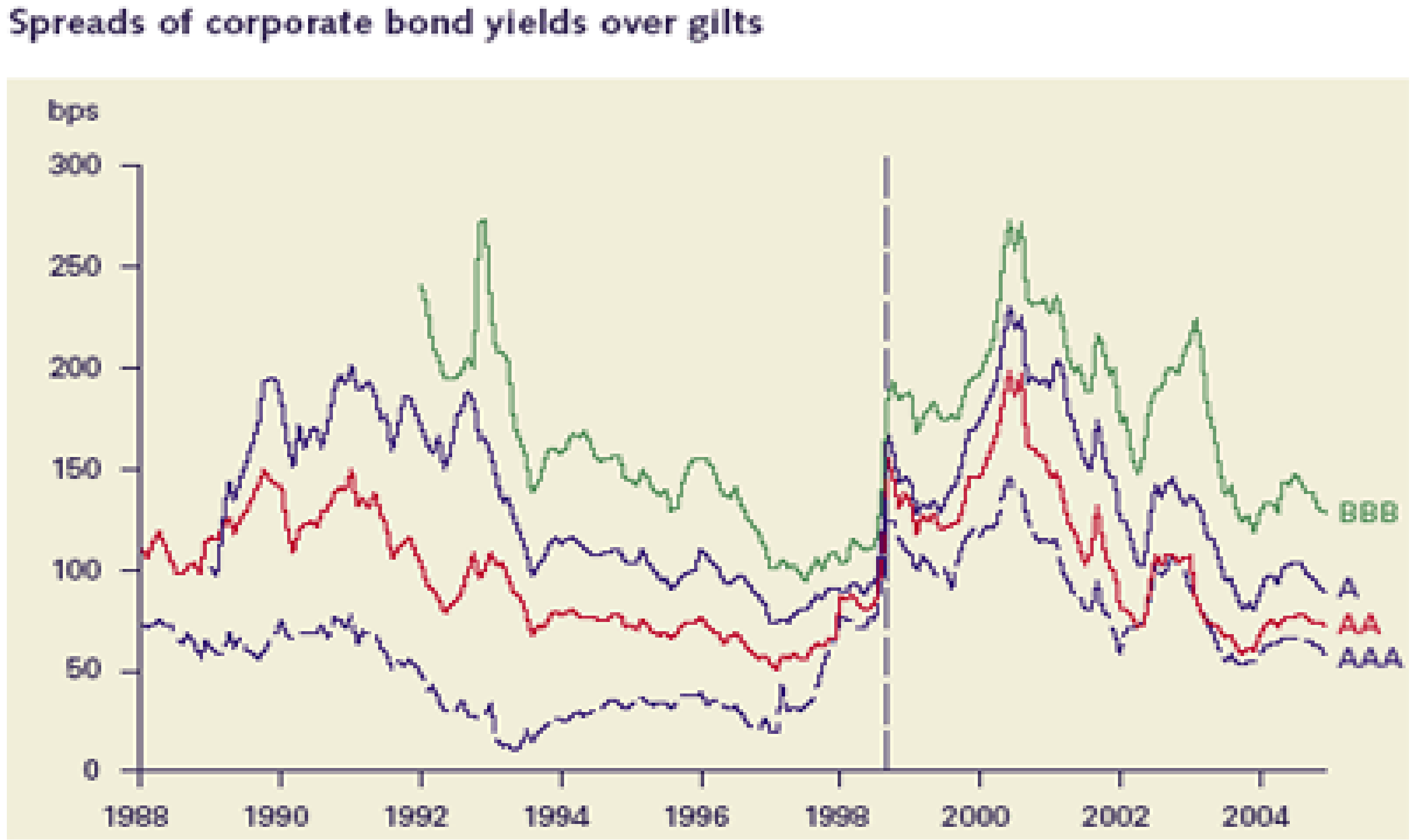
- **Sinking fund provision**
- Issuers may have to retire a proportion of the issue each year => sinking fund requirement
- Purpose: reduce credit risk
- If by law allowed to retire more than stipulated : accelerated sinking fund provision

Corporate Bonds and Ratings

- Heavily discussed these days… have a long history
- Three main competitors (Fitch, Moody's and S&P) with very similar systems, main distinction between investment and speculative (junk bonds) grade

	Moody's	Standard & Poor's	
Highest Quality	Aaa	AAA	Investment Grade
High Quality	Aa	AA	Investment Grade
Upper Medium	A-1, A	A	Investment Grade
Medium	Baa-1, Baa	BBB	Investment Grade
Speculative	Ba	BB	Not Investment Grade
Highly Speculative	B, Caa	B, CCC, CC	Not Investment Grade
Default	Ca, C	D	Not Investment Grade

Impact on yields…



Source: Watson Wyatt Europe

Ratings?

- To gauge their quality one may want to have a look at the correlation between defaults and prior ratings
- One may also want to have some insights on the frequency and the severity of the defaults
- Frequency of defaults is not enough => if coupon high enough defaulted bonds may end up providing an ex post return higher than one from a T-Bill
- Indeed, bondholders usually recover something in case of default!
- Default Loss Rate = Default Rate (100%- Recovery Rate)

- If default rate = 6%, and recovery rate = 30%, then the default loss rate is “only” 4.2%

Ultimate Recovery Rates on Bank Loan Defaults
Nominal and Discounted Values

(1988-2Q 2003)

	Observations	Ultimate Nominal Recovery	Ultimate Discounted Recovery	Standard Deviation
Senior Bank Debt	750	87.32%	78.8%	29.7%
Senior Secured Notes	222	76.03%	65.1%	32.4%
Senior Unsecured Notes	419	59.29%	46.4%	36.3%
Senior Subordinated Notes	350	38.41%	31.6%	32.6%
Subordinated Notes	343	34.81%	29.4%	34.1%

Source: Keisman, 2003, from Standard & Poor's LossStats™ Database, 2084 defaulted loans and bond issues that defaulted between 1987-2003. Recoveries are discounted at each instruments' pre-default interest rate.

Mortality rates and original rating

Table 15-2. Mortality Rates By Original Rating – All Rated Corporate Bonds (a) (1971 - 2006)

Years after issuance

		1	2	3	4	5	6	7	8	9	10
AAA	Marginal	0.00%	0.00%	0.00%	0.00%	0.05%	0.03%	0.01%	0.00%	0.00%	0.00%
	Cumulative	0.00%	0.00%	0.00%	0.00%	0.05%	0.08%	0.09%	0.09%	0.09%	0.09%
AA	Marginal	0.00%	0.00%	0.30%	0.14%	0.02%	0.02%	0.00%	0.00%	0.05%	0.01%
	Cumulative	0.00%	0.00%	0.30%	0.44%	0.46%	0.48%	0.48%	0.48%	0.53%	0.54%
A	Marginal	0.01%	0.08%	0.02%	0.06%	0.06%	0.09%	0.05%	0.20%	0.09%	0.05%
	Cumulative	0.01%	0.09%	0.11%	0.17%	0.23%	0.32%	0.37%	0.57%	0.66%	0.71%
BBB	Marginal	0.33%	3.13%	1.34%	1.24%	0.74%	0.31%	0.25%	0.19%	0.14%	0.40%
	Cumulative	0.33%	3.45%	4.74%	5.92%	6.62%	7.10%	7.33%	7.51%	7.63%	8.00%
BB	Marginal	1.15%	2.42%	4.32%	2.26%	2.53%	1.27%	1.61%	1.11%	1.71%	3.47%
	Cumulative	1.15%	3.54%	7.72%	9.88%	12.10%	13.20%	14.60%	15.56%	17.00%	19.88%
B	Marginal	2.84%	6.78%	7.35%	8.49%	6.01%	4.32%	3.95%	2.40%	1.96%	0.83%
	Cumulative	2.84%	9.43%	16.08%	23.21%	27.82%	30.94%	35.67%	35.26%	36.53%	37.06%
CCC	Marginal	8.12%	15.42%	18.75%	11.76%	4.14%	9.33%	5.79%	5.70%	0.85%	4.70%
	Cumulative	8.12%	22.30%	36.86%	44.30%	46.60%	51.57%	54.38%	56.98%	57.34%	59.36%

(a) Rated by S&P at issuance based on 1,955 issues

Source: Standard & Poor's (New York) and Author's Compilation

Source: Altman: http://people.stern.nyu.edu/ealtman/AboutCorporateDefaultRates.pdf

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Investment Grade vs. Non-Investment Grade (Original Rating)
Prices at Default on Public Bonds
(1974-2003)

Bond Seniority	N. of Issues	Median Price %	Average Price %	Weighted Price %	Standard Deviation %
Senior Secured					
Investment Grade	89	50.50	54.50	56.39	24.42
Non-Invest. Grade	283	33.50	36.63	31.91	26.04
Senior Unsecured					
Investment Grade	299	42.75	46.37*	44.05*	23.57
Non-Invest. Grade	598	30.00	33.41	31.83	23.65
Senior Subordinated					
Investment Grade	11	27.31	39.54	42.04	24.23
Non-Invest. Grade	411	26.50	31.48	28.99	24.30
Subordinated					
Investment Grade	12	35.69	35.64	23.55	23.83
Non-Invest. Grade	238	28.00	30.91	28.66	21.98
Discount					
Investment Grade	--	--	--	--	---
Non-invest. Grade	113	16.00	20.69	21.24	17.23
Total Sample	**2,054**	**30.04**	**34.76**	**30.78**	**24.38**

Notes: (*) Including WorldCom, the Average and Weighted Average were 43.53% and 30.45%
Non-rated issues were considered as non-investment grade

Source: Altman and Fanjul, 2004

Bonds may have embedded options

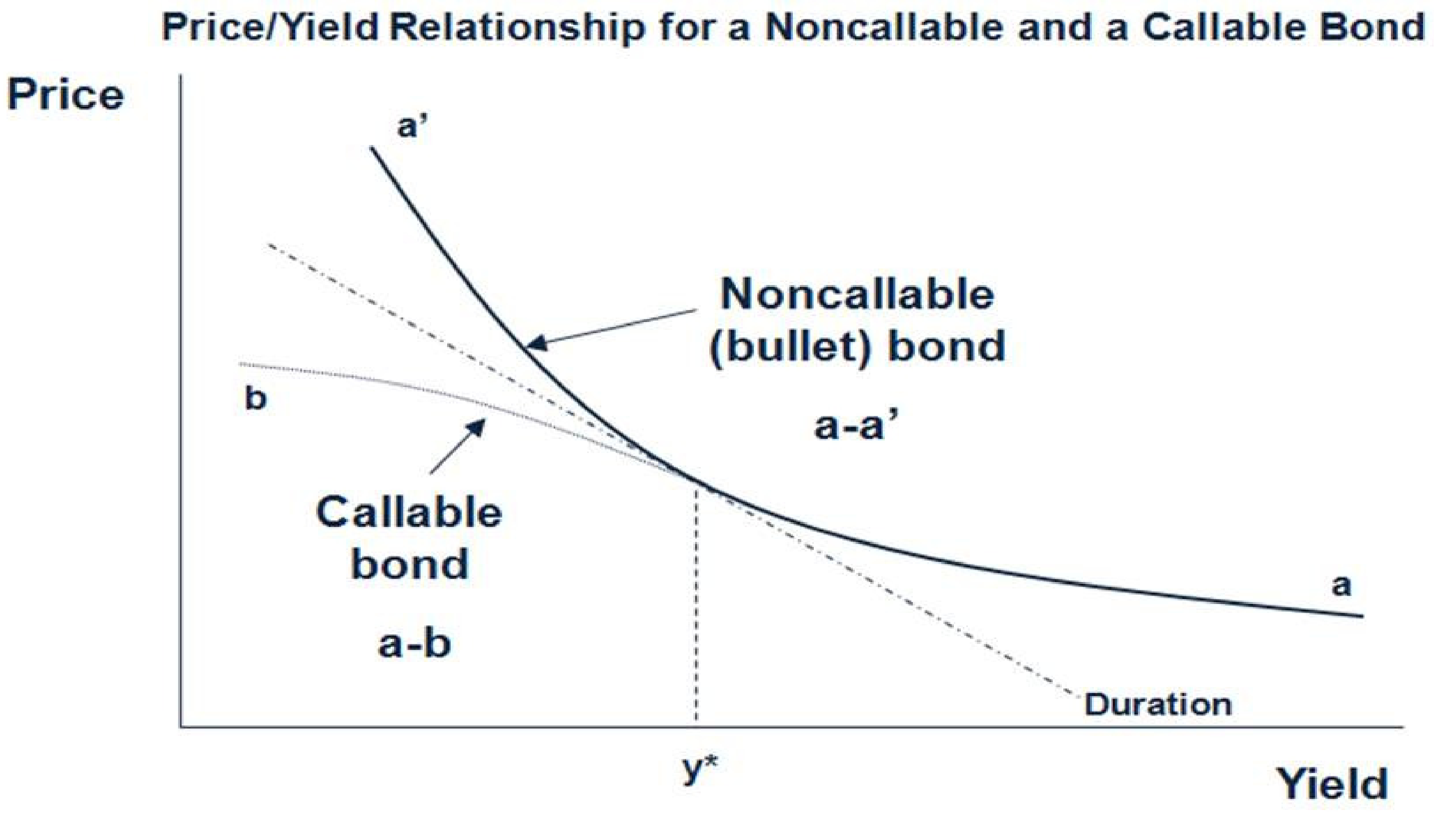
- Indeed callable and putable bonds include an option (it is embedded)
- The holder of a callable bond has given the right to the issuer to call back the bond before its stated maturity
- Bondholders face
  - Reinvestment risk => the issuer will call the bonds when prices have gone up
  - Price appreciation in a declining interest environment is limited because the market increasingly expects the bond to be called! => price compression

Price-Yield relationship

- For option free bonds, the relationship is convex
- When there are embedded call options, the relationship will actually only partially be convex (for the part when the call is least likely to be exercised i.e. for yields higher than a given threshold y*)
- On the other hand below that threshold investors take into account the likelihood that the bond might be called => so when the yield decreases the price increases less than for a traditional bond. For this region, the bond-price yield relationship is said to be negatively convex

- Visually…

Callable versus non callable bonds



Where: a-a' = price/yield relationship for a noncallable bond

a-b = price/yield relationship for a callable bond

How to price callable bonds?

- Callable bonds actually are made out of two components: the call option and a noncallable bond
- In other terms:
- Callable bond price = noncallable bond price – call option

- Indeed the owner of the callable bond has sold the call to the issuer, so the value of his bond has to be inferior to an equivalent noncallable bond

- The difference can be assessed on the previous graph

Computing the call value

- A seemingly reasonable way to attack the issue could be to use Black Scholes option pricing model. This would be wrong… Let's see why?
- Example from Fabozzi (2010)…
- Suppose a call on a ZC bond (face value of a 100), maturity in 2 years, current price 83.96, strike price 88, volatility = 0.1, risk free rate 6%
- By using Black Scholes call value = 8.116

- Same data but strike price = 100.25
- By using Black Scholes call value = 2.79

- Is this reasonable???
- When will you exercise this call?
- How can we explain this result?

Black Scholes and call on bonds

- Black Scholes associates a positive probability (even if very small) that the price may reach any positive value => fixed income instruments have however an explicit upper bound. Bond prices have a maximum return
- Black Scholes further assumes that short term rates remain constant over the life of the option. However the price of an interest rate option will change as interest rates change!
- Black Scholes further assumes that the variance of the price is constant over time. However as one draws closer to maturity a bond's price volatility declines…

- Need to take into account interest rate volatility => introduction of an interest rate lattice (tree) and to model interest rates

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Interest rate models

- Models should be close to reality and include statitsical properties of interest rate movements (Fabozzi, 2010)
  - A drift
  - Volatility
  - And mean reversion
- Most common models (and most used) : one factor models where one only tries to describe the behavior of short term interest rates
- Usually, stochastic process assumed
- Many different models (too long to be described)
  - Arbitrage free models => start with the observed price of a set of financial instruments. Assumption these are fairly priced
  - Equilibrium model => rely on fundamentals to describe the dynamics of the interest rates process

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Binomial interest rate tree

- Same principle as binomial trees used for the option valuation viewed before (with a few adaptations though)
- Assumption from one period to the next interest rates can only take two values. Interest rate model (Kalotay-Williams-Fabozzi, 1993)
- The one-year forward rate is assumed to follow a lognormal random walk,
- If σ = assumed volatility of the one-year forward rate

and $r_{1,L}$ = the lower one-year rate one year from now

and $r_{1,H}$ = the higher one-year rate one year from now

Then $r_{1,H} = r_{1,L}(e^{2\sigma})$

Tree

- Interest rate evolution

t=0	t=1	t=2
		$r_2(e^{4\sigma})$
	$r_{1,L}(e^{2\sigma})$	
r_0		$r_2(e^{2\sigma})$
	r_1	
		$r_{2,L}$

Option valuation

- 5.25% coupon bond with three years to maturity, callable in one year for 100$
- First => modeling interest rates, suppose there is an on-the-run similar bond with two years of maturity, volatility = 10%, coupon rate = 4%, current rate = 3.5%
  - Iterative process where one tries to find the one-year forward rate consistent with the observed price (a 100$), to start a first figure is given to $r_{1,L}$
  - Assumption high and low are equally probable
  - Here example for year 1 rates, if one wants to extend, need to have a three year on the run bond

Interest rate tree

t=0	t=1	t=2
		104
		$r_{2,HH}$
	P?	
	$r_{1,H} = r_{1,L}(e^{2\sigma})$	
100		
r_0		104
		$r_{2,HL}$
	P?	
	$r_{1,L}$	
		104
		$r_{2,LL}$

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Suppose we have computed all years and have

t=0	t=1	t=2
		$r_{2,HH} = 6.757\%$
	$r_{1,H} = 4.976\%$	
$r_0 = 3.5\%$		
		$r_{2,HL} = 5.532\%$
	$r_{1,L} = 4.074\%$	
		$r_{2,LL} = 4.530\%$

Once interest rate is modelled…

- Possibility to find the price of the noncallable bond and of the call
- For the non callable bond, just discount the future value by the expected one year forward rates
- For the callable bond, take into account that at each node where the price exceeds 100, the issuer will call the bond. In other terms the maximum price is 100!
- (See Excell File)

- In the same spirit as what we have seen before with one additional complicated thing: need to have an interest rate model

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Convertible bonds

- Convertible bonds are bonds which may be converted into a predetermined number of shares of the issuer
- The holder of the convertible bond has thus an option: the right but not the obligation to convert his bond into shares
- The number of shares received when exercising the right is called the conversion ratio
- Adjustments for splits and dividends are always included
- At issue, this provision entitles the bondholder to purchase the stock at the price given by:

- Price = Par Value of Convertible Bond / Conversion Ratio

Many different features

- Sometimes no clause at all => unprotected call
- In other cases, the issuer wants to be protected from conversion. Conversion may then only be exercised if the price of the underlying stock exceeds a given trigger price => protected call
- In some cases, not only does the price need to exceed a given threshold but it needs to remain above it for a specified number of trading days. This bonds are contingent convertible bonds (CoCo Bonds)
- Conversion leads to the creation of new stock ≠ traditional options where the exercise leaves the number of existing stock unchanged => warrant

Warrant

- Warrant (in this context): option written by the company itself on new stock
- Convertible bond = straight bond + warrant
- Warrant: The creation of new stock will have an impact on the stock price (there is a dilution effect!)
- So compared to a traditional call graph, the upward part of the graph will be a line with an slope inferior to 45°.
- Minimum price of the convertible bond:

1) Conversion value = conversion ratio x post conversion price of common stock
2) Value of the bond if it didn't have a conversion option ⇔ straight value

Why?

- Convertible bonds are attractive for potential buyers: allow to gain from a potential increase in stock price, but offers a protection if price decline
- If correctly priced, then no special gain though
- Often companies issue callable convertible bonds => transfers the time value of the conversion option to the shareholders
- For example if a company considers that its share value is too low to issue equity it may want to issue convertible bonds and call these once the price has risen enough (thereby limiting the dilution effect)