

Compound and hybrid (or exotic) securities

1

Summary of the lecture

- What are hybrid securities?
- An example. Definition of convertible bonds.
- Valuing convertible bonds
- Dilution effect
- An example of convertible bonds
- Why do firms issue convertible bonds, why should firms issue convertible bonds.
- (Time permitting) warrants and other hybrid securities

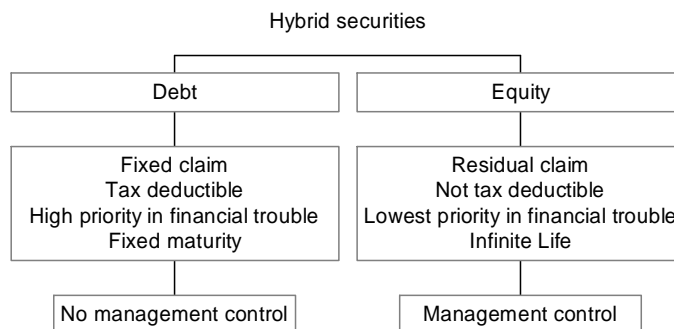
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What are hybrid securities?

- Approach 1:
 - Take instrument by instrument and study each of them:
 - ACES: Automatically Convertible Equity Securities (Goldman Sacks)
 - CHIPS: Common-linked Higher Income Participating debt Security (Bear Stern)
 - CRESTS: Convertible Redeemable Equity Structured Trust Securities (NB-Montgomery)
 - ELKS: Equity Linked Debt Securities (Salomon)
 - LYONS: Liquid Yield Option Notes (Merrill Lynch)
 - PERCS: Preferred Equity Redemption Cumulative Stock (Morgan Stanley)

3

Debt, equity and hybrid securities



4

Convertible bond - definition

- **Definition:** A convertible bond is a bond that can be converted, at any time before maturity (expiration date), into a given number of shares of equity (conversion ratio). The investor has the choice of when and if to convert into stock. If the investor does not convert the bond, he continues to receive principal and interest payments from the bond.

5

Convertible bond - mechanics

- **Conversion ratio:** The number of shares which each bond converts to (fixed); specified as part of the agreement.
- **Conversion price:** The effective price at which an investor purchases stock when they convert their bond. It is equal to the value of the bond (market value) divided by the conversion ratio (fixed). Strike price.
- **Conversion value:** The current value of the shares for which the bonds can be exchanged. It is equal to the conversion ratio times the current stock price (variable)
- **Conversion premium:** The premium is the difference between the conversion price and the current price of the stock over the current price (variable). Possible different definition.

6

Convertible bond - mechanics an example

- Consider a bond with a par value of \$1,000, with the conversion ratio of 50. Assume the current stock price is \$15
- **Conversion ratio= 50**
- **Conversion price = $1,000/50=\$20$**
- **Conversion value = $15*50=750$**
- **Conversion premium = $(20-15)/15=33.3\%$**
- or equivalently, **$(20*50-15*50)/15*50=33.3\%$**

7

Valuing a convertible bond

- A convertible bond can be thought of as a straight bond plus an option to convert the bond into stock (conversion option).
 - The value of the conversion option is determined by the variables that affect call option values:
 - the conversion ratio (which determines the strike price) (+);
 - the underlying stock price (+);
 - the life of the convertible bond (+);
 - the variance in the stock price (+);
 - the level of the risk free interest rates (+);
 - the dividends paid on the stock (-);

8

Valuing a convertible bond

- The price of a convertible bond must always be at least as great as the price of an otherwise similar straight bond.
 - Note that the effect of increased risk in the firm can cut both ways in a convertible bond: it will decrease the value of the straight bond portion, while increasing the value of the conversion option.
 - These effects implies that the bond will be less exposed to changes in the firm's risk than a straight bond.

9

Valuing a convertible bond - an example

- General idea: The value of a convertible bond can be decomposed into straight debt and equity components using a simple approach.
- The price of the bond is the sum of the straight debt and the call option (that is the equity component)
- if you know the value of the straight bond component and the market price of the convertible bond, you can derive the value of the call option.

10

Valuing a convertible bond - an example

- The value of the bond component can be estimated using:
 - the coupon payments on the convertible bonds
 - the maturity of the bond
 - the mkt interest rate the company would pay on a straight bond
- the value of the equity component is:
= Price of convertible bond - Value of straight bond component

11

Valuing a convertible bond - an example

- A firm issue \$50M (50,000) of convertible bonds at the face value of \$1,000. $T=20$ and the annual coupon is 12%. A straight bond has a 14% required rate. The conversion ratio is 20. There are 5M of shares outstanding
 1. Compute conversion price
 2. Value of the bond component
 3. Value of the option component
 4. Value of the firm, decomposition into debt and equity
 5. Payoff to bondholders at maturity
 6. Payoff to equityholders at maturity

12

1. Compute conversion price

- Conversion price = $1,000/20 = \$50$

13

2. Value of the Bond Portion

$$P_{bond} = \sum_1^{20} \frac{120}{(1+.14)^t} + \frac{1000}{(1+.14)^{20}} = \$867.54$$

14

3. Value of the option component

Value of Conversion Option= Value of the
equity component=1,000-867.54=\$132.46

15

4. Decomposition of debt and equity

Debt component of Convertible
bonds=50,000*\$867.54=\$43.4M

Equity component of convertible bonds=
50,000*\$132.46=\$6.6M

16

5. Payoff to bondholders (at maturity)

The bondholders will convert only if the price of the stock after conversion (P_{AC}) is :

$$P_{AC} * 20 \geq \$1,120$$

$$P_{AC} \geq \$56$$

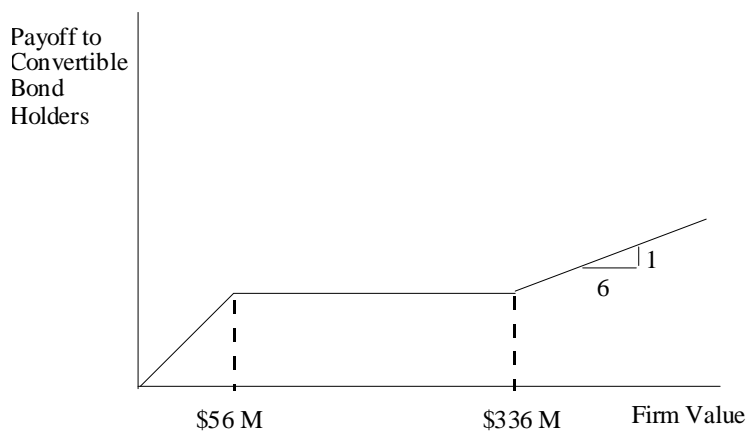
When $P_{AC} = \$56$,

$$V_{firm} = \$336 \quad [56 = V_{firm} / (5M + 1M)]$$

Conversion should occur for $V_{firm} \geq \$336$

17

5. Payoff to bondholders (at maturity)



18

6. Payoff to equityholders (at maturity)

19

Application of Option pricing models

- Option pricing models can be used to value the conversion option three caveats
 - conversion options are long term, so the assumption of constant variance is unreasonable
 - conversion options are often exercised before expiration (i.e. American options)
 - conversion options result in stock dilution (in practice investors often ignore dilution when they calculate conversion value)

20

Effect of stock dilution

- To take into account stock dilution, you have to modify the stock price allowing for expected dilution from option exercise.
- This is why a conversion option is worth less than a standard option on the stock.
 - Consider the case where a convertible is issued and firm value then increases to V_{firm} , high enough for convertible bondholders to convert their bonds into stock.

21

Example

All equity firm with a stock price of \$50

$N_{\text{shares}}=1\text{M}$

zero-coupon convertible bonds, face value=1,000

Number of convertible bonds=7,500

Conversion ratio=13.33

Conversion price=?

$$=1,000/13.33=\$75$$

22

Example

1. At maturity for which value of the firm is it convenient to convert?
2. Suppose the value of the firm is \$90M. What is the price after conversion? What is the price without conversion? How can you explain the difference?

23

1. At maturity for which value of the firm is it convenient to convert?

- What is the percentage of shares, the convertible bondholders would get by converting (at maturity)?

$$\begin{aligned} \text{New shares}/(\text{old shares}+\text{new shares})= \\ = (7500 * 13.33) / (1M + 7500 * 13.33) = 9.09\% \end{aligned}$$

- 9.09% of the firm should be worth more than debt to convince the bondholders to convert:

$$\begin{aligned} 9.09\% V_{\text{firm}} > \$7.5M \\ V_{\text{firm}} > \$82.5 \end{aligned}$$

24

Suppose the value of the firm is \$90M.
What is the price after conversion?
What is the price without conversion?

$$P_{AC} = \frac{V_{firm}}{N_{WOC} + N_C} = \frac{\$90million}{1.1_million_of_shares} = \$81.82$$

$$P_{WOC} = \frac{V_{firm} - D}{N_{WOC}} = \frac{\$82.5M}{1_million_of_shares} = \$82.5$$

- The difference between \$82.50 and \$81.82 is because of dilution.

25

Why do companies issue convertible debt?

- Convertible debt is cheaper than straight debt (27% of the CFOs)
- Convertible debt is cheaper than selling stocks (68% of CFO), because usually it is sold at a higher price than the current price of the stock.

26

Why should companies issue convertible debt?

- **Management and market disagree about the risk of the firm:** the market overestimate the variance of the payoffs. The market will require higher promised (coupon) payments on straight debt. Managers will be willing to provide this option since they believe it is unlikely to finish in the money.
- **Prevent asset substitution problem.** Equity holders have less of an incentive to increase the riskiness of the firm's projects if debt holders can choose to be equity holders or debt holders after they know which project management has chosen.

27

Indeed...

- The birth of this instrument is attributed to J.J. Hill, the railroad magnate, in 1881.
- Hill believed that the market was ascribing too much risk to his rail project and needed an innovative way to secure long term financing. Unwilling to sell stock until his planned expansion had reaped financial rewards, yet shut out from the traditional debt market, Hill issued a convertible bond

28

Empirical evidence

- Young firms are more likely to issue convertibles
- Highly levered firm are more likely to issue convertibles
- high growth firm are more likely to issue convertibles.
 - Consistent with both hypothesis, higher variability of earnings.

29

When is it optimal to convert?

- Recall option theory
- Dividends and interest.
 - As long as interest payments are greater than dividend payments, conversion should be postponed. It makes sense to exercise the option early if the net dividend (**dividend payment** minus **interest payment**) exceeds the difference between the **option value** and its **intrinsic value**.

30

Warrants - definition

- **Definition:** A warrant is the right to buy one share of stock at a given price. Warrants are call options sold by firms on their own stock. The number of shares outstanding increases when warrants are exercised. Firms can sell warrants separately or bundled with bonds. In this case they are equivalent to a convertible bond.
 - Dilution effect. The exercise of the warrant will cause the same dilution as the conversion of the option imbedded in a convertible bond. Thus old shareholders always lose when the warrants are exercised.

31

Callable Bonds

- **Callable Bonds.** A callable bond is a bond which the issuer has the option of repurchasing at a specified price (the call price) at any time to maturity.
 - **Imbedded option.** The callable bond is a straight bond minus a call option on the bond. The value of the callable bond can be calculated as the value of an equivalent straight bond minus a call option on the bond

32

What have you learned?

Convertible bonds (and other hybrid securities):

- how to determine the value of the different components?
- what is the dilution effect?
- when is it optimal to convert?
- why should a firm issue hybrid securities.

Practice problems: at the end of the lecture notes,
homework 5, past exams