CHAPTER 28: APPLICATION OF OPTION PRICING THEORY IN CORPORATE FINANCE

28-1
The primary difference between options and futures contract is that a futures contract imposes an obligation on both the buyer and the seller of the contract to carry out the contract. An options contract, on the other hand, provides the buyer with a right, which he can choose to exercise.

28-2
We cannot make the same assumption regarding callable bonds, because they will usually be exercised before expiration. Unlike stocks, where the dividend yield is relatively small, callable bonds have high coupons. One of the benefits of early exercise is that these coupons can now be replaced with lower interest payments.

28-3
The conversion option in a convertible bond is linked to the underlying bond, i.e., if the conversion option is exercised the underlying bond ceases to exist. In contrast, a warrant is a self-standing security. Exercising a warrant does not affect any other security.

28-4
a. Value of Conversion Option
S = $20 Dividend Yield = 5%
K = $25 Standard Deviation = 10%
t = 10 r = 10%
Value per Call = $2.93
Number of Calls/Bond = 40
Value of Conversion Option = $2.93 * 40 = $117.20

b. Value of the Straight Bond Portion = $80 (PVA,12%,10 years) + $1,000/(1.12)^ 10 = $773.99

28-5
The similar non-callable bond would have a price of $962.38
The call option = $962.38 - $900 = $62.38

28-6
S = PV of $25 million a year for 20 years at 16% = $148.22 million
K = Cost of Taking Project = $300 million
t = 10 years
Standard Deviation = 20%
r = 12%
y = Dividend Yield = 1/ Project Life = 10%

28-7
Using put-call parity, we can value a call with K = 50 and a 1-year life,
Call - Put = $S - Ke^{-rt}$ = $12.00 + $45 - $50 $e^{-(.1)}$ = $11.76
We can also value of call with a strike price of $75,
Call = $31 + $45 - $75 e-(.1) = $8.14
The value of the executive package can be estimated as follows:
Guaranteed Payment = $500,000
Value of Bonus Package:
10,000 *($11.76-$8.14) = $36,200
(This is a capped call, since the executive bonus is capped off at $75.)

28-8
a. NPV of Project = -$5,000,000 + $500,000 (PVA,15%,10) + $5,000,000/$1.15^{10}$ = -$1,254,692

b. Value the option to abandon (per square foot)
S = $50 Standard Deviation = Standard Deviation in Price/SqF
K = $50 = 46.84%
t = 5 years Riskless Rate = 6%
Value per put option = $11.54 (for
Value for 100,000 square feet = 100,000 * $11.54 = $1,154,000

28-9
a. True. Equity investors cannot lose more than their equity investment.

b. False. They can make equity more valuable, not the firm.

c. True. It transfers wealth to the bondholders.

d. True. This is the equivalent of the life of the option.

e. True. There is a transfer of wealth to bondholders.

28-10
a. Value of the firm = 40 (1-0.4)/(.10-.05) = $480 million

b. S = $480
K = $500

t = 5 years
r = 5%
s = 0.125
Note: Since the dividends are paid to the stockholders, and we are valuing equity, it is not shown as a dividend yield.
Value of Call (Equity) = $106.39

c. Value of Debt = $480 - $106.39 = $373.61 million
Appropriate Interest Rate = $(500/373.61)^{(1/5)} - 1 = 6.00\%$

28-11
Based on the call-put parity that $C = P + S + K \exp^{-rt}$, the following interpretation can be established:

Equity holders	**Bondholders**
1. Equity holders own the firm interest and	1. Bondholders are owed $500 million in principal.
2. Equity holders owe $500 million in interest the firm and principal to bondholders. to the equity	2. Bondholders have sold a put option on With an exercise price of $500 million holders.
3. Equity holders own a put option on the firm with exercise price of $500 million.	

28-12

a. Firm Value $= \frac{\$850 * 0.6 * (1.20) * \left[1 - \frac{(1.20)^5}{(1.10)^5}\right]}{1.05} + \frac{\$850 * 0.6 * 1.2^5 * 1.05}{(1.10)^5} = \$19,883$

b. Standard Deviation of Firm = $[(0.67)^2(0.35)^2 + (0.33)^2 (0.15)^2 + 2 (0.67)(0.33) (.5) (.35) (.15)$
$= 0.2619$
S = 19,883.21
r = 5%
K = FV of Debt = 10,000
Variance = $0.2619^2 = 0.07$
t = Average Duration of Debt = 3
Dividend Yield = 0
d1 = 2.07 N(d1) = 0.98
d2 = 1.62 N(d2) = 0.95
Value of Call (Equity) = $11,350

c. Market Value of Equity = $12,200 Implied Variance = 0.25
Implied Standard Deviation = 0.5

d. Market Value of Debt = $8,534

28-13

A. PV of Inflows = 400,000 * 0.85 * (1 - $1.04^{25}/1.07^{25}$)/(.07 - .04) -400,000 * 0.40 * (1 - $1.03^{25}/1.07^{25}$)/(.07 - .03) = $3,309,756

Fixed Costs associated with opening

= -3,000,000

NPV = 3,309,756 -3,000,000 = $309,756

B. S = 3,309,756

K = 3,000,000

t = 25

r = 7%

σ = 0.25

y = 1/25 = 4%

Value of the Call Option = $828,674

C. The latter considers the option characteristics of owning the mine, i.e., that copper prices may go up, and is higher.

28-14

Current Value of Developed Reserve = 10,000,000 * ($20 - $6) = $140,000,000
Exercise Price = Cost of Developing Reserve = $120,000,000
t = 20 years
r = 7%
s = 20%
y = 4%
Value of Call (Natural Resource Reserve) = $37,360,435

28-15

a. NPV of Project = $250 - $200 = $50 million

b. The option has the following characteristics:
S = 250
K = 200
r = 8%

t = 5
Variance = 0.04
Dividend Yield = 12.5/250 = 5%
Value of Call (Project Rights) = $68.68

c. The latter captures the value of delaying the project. The difference between the two values will increase as the variance in the project cash flows increases.

28-16
a. S = PV of Cash Inflows on Project = 250
K = Cost of Taking Project = 500
t = 10 years
r = 6%
s = 0.6
y = 10/250 = 4%
Value of Call (Product Patent) = $95 million

b. It is an increasing function of the variance in project cash flows. This analysis suggests that the rights to products in technologically volatile areas are likely to be worth a great deal, even though the products may not be viable now.

28-17
a. False. It is the uncertainty that makes the project valuable.

b. True. Without this protection, there would be no option.

c. False. The value of these projects can be accounted for in the growth rate.

d. False. It may pay to wait for the project to become more valuable.

e. True.

28-19
a. Conversion Ratio = 30 shares/bond. Conversion Price = $27

b. Conversion Premium = $1,177 - ($30 * $27) = $367

c. Value of Straight Bond Portion = $40 (PVA,8%,20) + $1,000/$1.08^{20}$ = $607.27

28- 20
a. Value of Conversion Option
S = $15
k = $20
t = 15 years
r = 8%
Variance = 16%

The value of this option (without allowing for dilution) = $11.14
Value of this option (with dilution) = $10.77
Value of Conversion Option = $10.77 * 50 = $538.50

b. Value of Straight Bond Portion = $50 (PVA,10%,15)+ $1,000/$1.1^{15}$ = $619.70

c. If the bonds are issued at par, instead of the fair market value of $1158.20, the existing stockholders in the firm will lose, while the new bond buyers will gain.

d. Forced conversion would lower the value of the convertible bond.

28-21
a. False. Callable bonds should sell for less.
b. True. There is a greater chance that they will not last until maturity.
c. True. To reflect the lower price.
d. False. Callable bonds will be less sensitive to interest rate declines especially.