SESSION 23: VALUING EQUITY IN DISTRESSED FIRMS AS AN OPTION

Valuing Equity as an option

- The equity in a firm is a residual claim, i.e., equity holders lay claim to all cashflows left over after other financial claim-holders (debt, preferred stock etc.) have been satisfied.
- If a firm is liquidated, the same principle applies, with equity investors receiving whatever is left over in the firm after all outstanding debts and other financial claims are paid off.
- The principle of limited liability, however, protects equity investors in publicly traded firms if the value of the firm is less than the value of the outstanding debt, and they cannot lose more than their investment in the firm.

Equity as a call option

- The payoff to equity investors, on liquidation, can therefore be written as:

Payoff to equity on liquidation	= V - D	if V > D
	= 0	if V ≤ D

where,

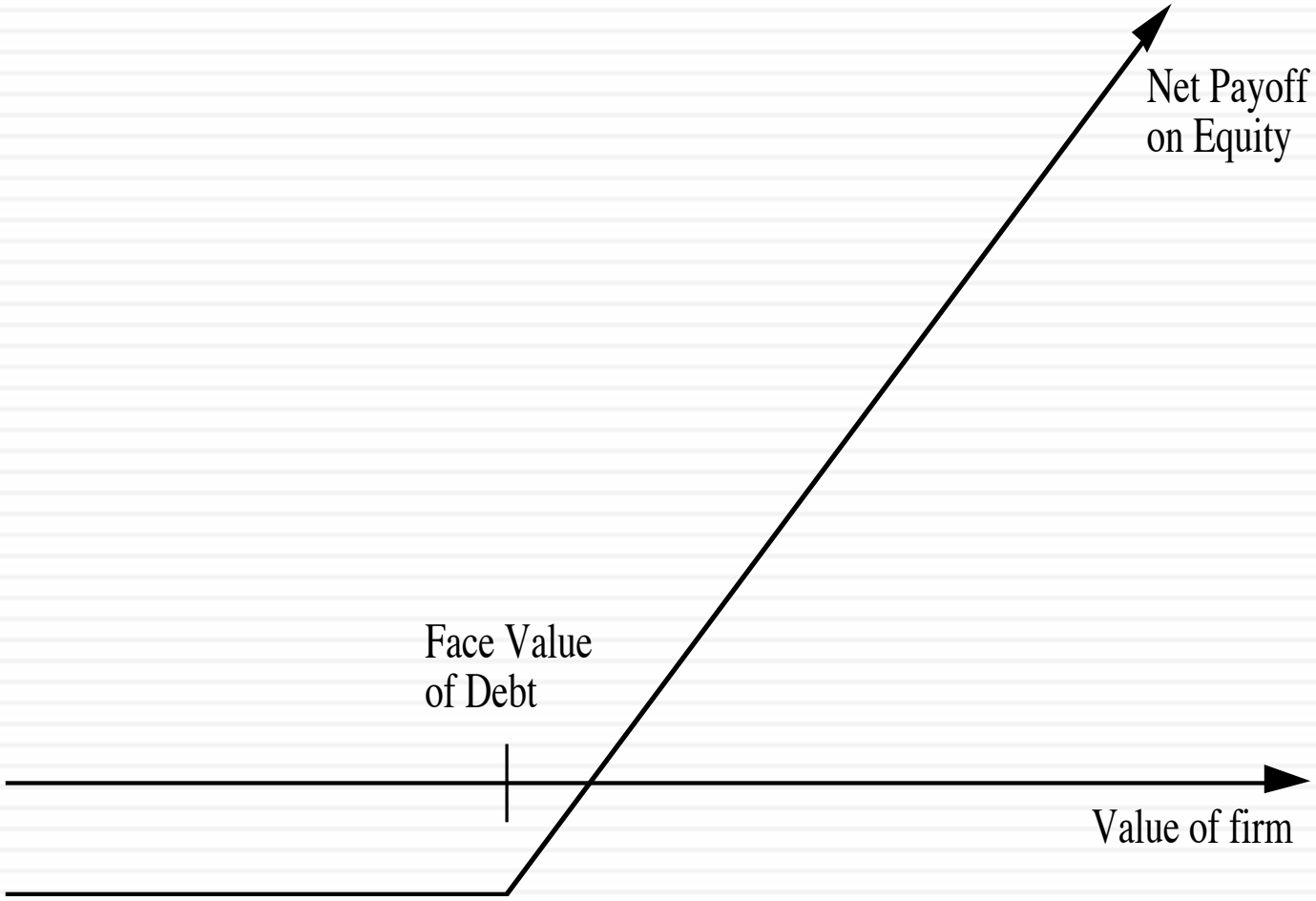
V = Value of the firm

D = Face Value of the outstanding debt and other external claims

- A call option, with a strike price of K, on an asset with a current value of S, has the following payoffs:

Payoff on exercise	= S - K	if S > K
	= 0	if S ≤ K

Payoff Diagram for Liquidation Option



Application to valuation: A simple example

- Assume that you have a firm whose assets are currently valued at $100 million and that the standard deviation in this asset value is 40%.
- Further, assume that the face value of debt is $80 million (It is zero coupon debt with 10 years left to maturity).
- If the ten-year treasury bond rate is 10%,
  - how much is the equity worth?
  - What should the interest rate on debt be?

Model Parameters

- Value of the underlying asset = S = Value of the firm = $ 100 million
- Exercise price = K = Face Value of outstanding debt = $ 80 million
- Life of the option = t = Life of zero-coupon debt = 10 years
- Variance in the value of the underlying asset = $\sigma 2$ = Variance in firm value = 0.16
- Riskless rate = r = Treasury bond rate corresponding to option life = 10%

Valuing Equity as a Call Option

- Inputs to option pricing model
  - Value of the underlying asset = S = Value of the firm = $ 100 million
  - Exercise price = K = Face Value of outstanding debt = $ 80 million
  - Life of the option = t = Life of zero-coupon debt = 10 years
  - Variance in the value of the underlying asset = $\sigma 2$ = Variance in firm value = 0.16
  - Riskless rate = r = Treasury bond rate corresponding to option life = 10%
- Based upon these inputs, the Black-Scholes model provides the following value for the call:
  - d1 = 1.5994 N(d1) = 0.9451
  - d2 = 0.3345 N(d2) = 0.6310
- Value of the call = 100 (0.9451) - 80 exp(-0.10)(10) (0.6310) = $75.94 million
- Value of the outstanding debt = $100 - $75.94 = $24.06 million
- Interest rate on debt = ($ 80 / $24.06)1/10 -1 = 12.77%

The Effect of Catastrophic Drops in Value

- Assume now that a catastrophe wipes out half the value of this firm (the value drops to $ 50 million), while the face value of the debt remains at $ 80 million. What will happen to the equity value of this firm?

a. It will drop in value to $ 25.94 million [$ 50 million - market value of debt from previous page]

b. It will be worth nothing since debt outstanding > Firm Value

c. It will be worth more than $ 25.94 million

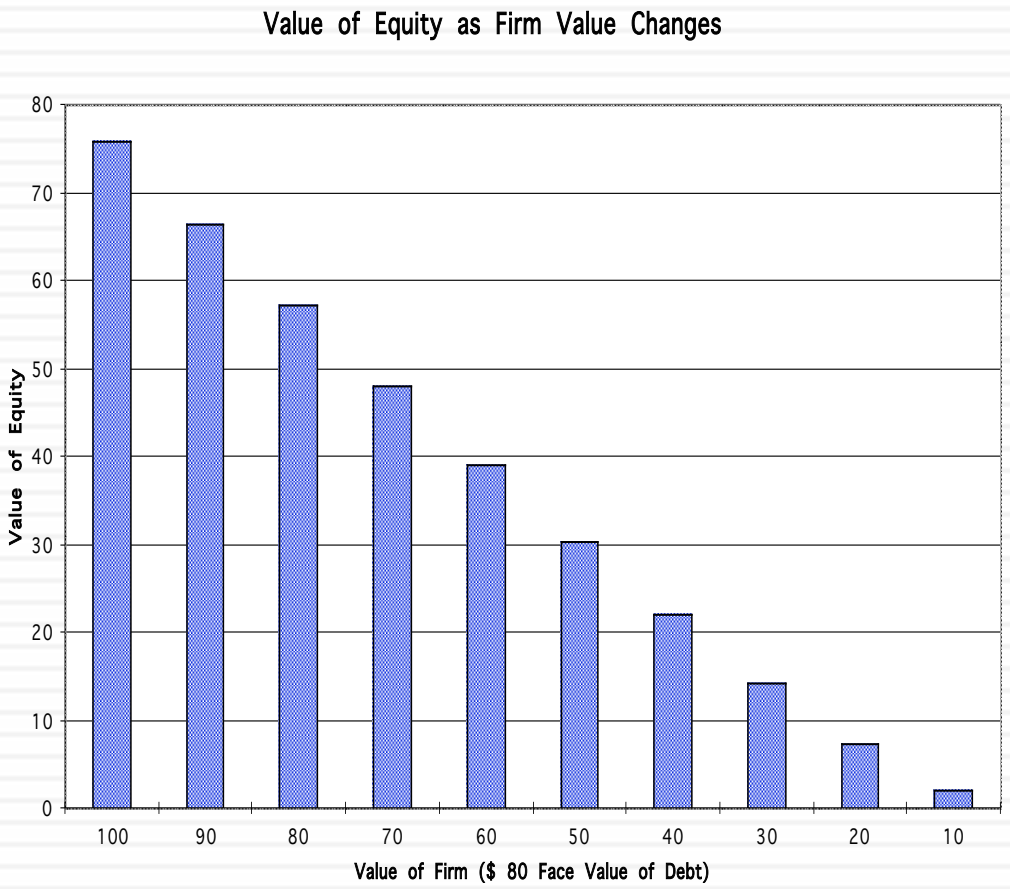
Valuing Equity in the Troubled Firm

- Value of the underlying asset = S = Value of the firm = $ 50 million
- Exercise price = K = Face Value of outstanding debt = $ 80 million
- Life of the option = t = Life of zero-coupon debt = 10 years
- Variance in the value of the underlying asset = $\sigma 2$ = Variance in firm value = 0.16
- Riskless rate = r = Treasury bond rate corresponding to option life = 10%

The Value of Equity as an Option

- Based upon these inputs, the Black-Scholes model provides the following value for the call:
  - d1 = 1.0515 N(d1) = 0.8534
  - d2 = -0.2135 N(d2) = 0.4155
- Value of the call = 50 (0.8534) - 80 exp(-0.10)(10) (0.4155) = $30.44 million
- Value of the bond= $50 - $30.44 = $19.56 million
- The equity in this firm drops by $45.50 million, but not by $50 million, because of the option characteristics of equity.
- This might explain why stock in firms, which are in Chapter 11 and essentially bankrupt, still has value.

Equity value persists ..



Obtaining option pricing inputs in the real worlds

Input	Estimation Process
Value of the Firm	• Cumulate market values of equity and debt (or) • Value the assets in place using FCFF and WACC (or) • Use cumulated market value of assets, if traded.
Variance in Firm Value	• If stocks and bonds are traded, $\sigma^2_{firm} = w_e^2 \sigma_e^2 + w_d^2 \sigma_d^2 + 2 w_e w_d \rho_{ed} \sigma_e \sigma_d$ where σ_e^2 = variance in the stock price w_e = MV weight of Equity σ_d^2 = the variance in the bond price w_d = MV weight of debt • If not traded, use variances of similarly rated bonds. • Use average firm value variance from the industry in which company operates.
Value of the Debt	• If the debt is short term, you can use only the face or book value of the debt. • If the debt is long term and coupon bearing, add the cumulated nominal value of these coupons to the face value of the debt.
Maturity of the Debt	• Face value weighted duration of bonds outstanding (or) • If not available, use weighted maturity