Security Analysis

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Session 4

Dr Cesario MATEUS
www.cesariomateus.com

Valuation Models II

Discounted Abnormal Earnings: Value of firm's equity is expressed as the sum of its book value and the present value of the forecasted abnormal earnings.

Discounted abnormal earnings growth: Value of the firm's equity as the sum of its capitalized next-period earnings forecast and the present value of forecasted abnormal earnings growth beyond the next period.

Real Options: Contingent Claim (Option) Valuation

Abnormal Earnings Model (Residual Income or Economic Profit Model)

Company value is based on book value of capital invested and the present value of expected abnormal earnings

Looks at whether management's decisions cause a company to perform better or worse than anticipated.

The model says that investors should pay more than book value if earnings are higher than expected and less than book value if earnings are lower than expected.

Abnormal Earnings: actual return – expected return on invested capital

Less sensitive to future forecasts than the FCF and DDM models

Book value accounts for 72% of the valuation.

The Discounted Abnormal Earnings Valuation Model

The expected book value of equity for existing shareholders at the end of year 1 (BVE1) is simply the book value at the beginning of the year (BVE0) plus expected net profit (Net Profit1) less expected dividends (Dividends1).

$$Dividend_1 = Net\ \mathrm{Pr}ofit_1 + BVE_0 - BVE_1$$

Substituting this identity for dividends into the dividend discount formula and rearranging the terms, equity value can be rewritten as follows:

$$Equity\ Value = Book\ value\ of\ equity + PV\ of\ \exp ected\ future\ abnormal\ earnings$$

If a firm can earn only a normal rate of return on its book value , the investors should be willing to pay no more than book value for its shares.

Investors will pay more/less than book value if earnings are above/below this normal level.

$$Equity\ value = BVE_0 + \frac{Net\ \Pr ofit_1 - r_e \times BVE_0}{(1+r_e)^1} + \frac{Net\ \Pr ofit_2 - r_e \times BVE_1}{(1+r_e)^2}$$

The deviation of a firm's market value from book value depends on its ability to generate "abnormal earnings".

Formulation also implies that: firm's equity value reflects the cost of its existing net assets (book equity) plus the net present value of future growth options (shown by the cumulative abnormal earnings)

Example:

Suppose a company depreciate its fixed assets using the straight line method.

Accounting based earnings: $20 million lower than dividends in each of the next 3 years.

Further: book value of equity at the beginning of years 2 and 3 equals prior year's beginning book value plus prior year's earnings minus prior year's dividends.

re =10%

Firm's beginning book value, earnings, abnormal earnings and valuation

Year	Beginning book value	Earnings	Capital Charge	Abnormal Earnings	PV Factor	PV Abnormal Earnings
	(a)	(b)	(c) = re × (a)	(d) = (b) – (c)	(e)	(d) × (e)
1	$60	$20	$6	$14	0.9091	$12.7
2	$40	$30	$4	$26	0.8264	$21.5
3	$20	$40	$2	$38	0.7513	$28.6
Cumulative PV of Abnormal Earnings						$62.8
+ Beginning Book Value						$60.0
= Equity Value						$122.8

Note: under the same assumptions of earnings forecast and cash flows and since both discounted cash flow model and abnormal earnings model are derived from the dividend discount model the value of equity will be exactly the same.

Is the estimation affected by managers choice of accounting methods?

Provided that analysts recognize the impact of differences in accounting methods on future earnings and earnings forecasts, the accounting effects should not have any influence on their value estimates.

Accounting choices that affect a firm's current earnings also affect its book value, and therefore they affect the capital charges used to estimate future abnormal earnings.

Conservative accounting not only lowers a firm's current earnings and book equity but also reduces future capital charges and inflates its future abnormal earnings.

Example: Suppose that managers are conservative and expense some unusual costs that could have been capitalized as inventory in year 1.

Earnings and book value lower $10 million.
Inventory is sold in year 2.

Firm's beginning book value, earnings, abnormal earnings and valuation

Year	Beginning book value	Earnings	Capital Charge	Abnormal Earnings	PV Factor	PV Abnormal Earnings
	(a)	(b)	(c) = re × (a)	(d) = (b) – (c)	(e)	(d) × (e)
1	$60	$10	$6	$4	0.9091	$3.6
2	$30	$40	$3	$37	0.8264	$30.6
3	$20	$40	$2	$38	0.7513	$28.6
Cumulative PV of Abnormal Earnings						$62.8
+ Beginning Book Value						$60.0
= Equity Value						$122.8

As far as the analyst is aware of biases in accounting data abnormal earnings based valuations are unaffected by the variation in accounting decisions.

However, if the analyst misinterpret the decline as indicating that the firm was having difficulty moving its inventory rather than it had used conservative accounting, the analyst might reduce expectations of future earnings.

The Discounted Abnormal Earnings Growth Valuation Method

Abnormal earnings are the amount of earnings that a firm generates in excess of the opportunity cost of equity funds used.

Abnormal earnings growth = change in abnormal earnings

$$\left(Net\ \ \Pr ofit_2 - re \times BVE_1\right) - \left(Net\ \ \Pr ofit_1 - re \times BVE_0\right)$$

$$\left(Net\ \Pr ofit_2 - re \times \left[BVE_0 + Net\ \Pr ofit_1 - Dividend_1\right]\right) - \left(Net\ \Pr ofit_1 - re \times BVE_0\right)$$

$$Net\ \ \Pr ofit_2 + re \times Dividend - (1 + re) \times Net\ \ \Pr ofit_1$$

$$\Delta Net\ \ \Pr ofit_2 - re \times \left(Net\ \ \Pr ofit_1 - Dividend_1\right)$$

$$Equity value = \frac{Net\,Profit_1}{re} + \frac{1}{re}\left[\frac{\Delta Net\,Profit_2 - re\left(Net\,Profit_1 - Dividend_1\right)}{\left(1+re\right)} + \frac{\Delta Net\,Profit_3 - re\left(Net\,Profit_2 - Dividend_2\right)}{\left(1+re\right)^2} + ..\right]$$

The equity value is defined as the capitalized sum of (1) next period earnings and (2) the discounted value of abnormal growth beyond the next period.

Year	Earnings	Retained Earnings	Normal earnings Growth	Abnormal Earnings Growth	PV factor	PV abnormal earnings growth
	(a)	(b) = (a)- dividends	(c) = re × (b)t-1	(d) =Δ (a) – (c)	(e)	(d) × (e)
1	$20	-$20				
2	$30	-$20	-$2	$12	0.9091	$10.91
3	$40	-$20	-$2	$12	0.8264	$9.92
4	0	0	-$2	-$38	0.7513	-$28.55
Cumulative PV of Abnormal Earnings growth						-$7.72
+ Earnings in year 1						$20.0
= Equity Value						$12.28
× 1/re = Equity value						$122.8

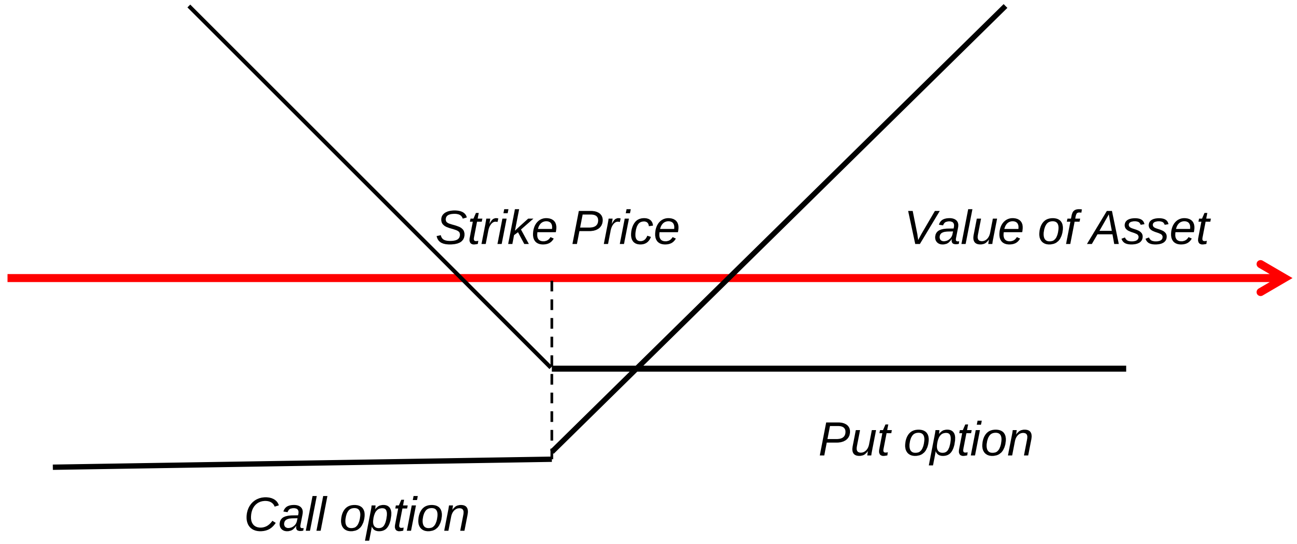
Contingent Claim (Option) Valuation

Options have several features

- They derive their value from an underlying asset, which has value
- The payoff on a call (put) option occurs only if the value of the underlying asset is greater (lesser) than an exercise price that is specified at the time the option is created. If this contingency does not occur, the option is worthless.
- They have a fixed life

Any security that shares these features can be valued as an option.

Option Payoff Diagrams



Equity as a Call Option

The payoff to equity investors (shareholders), on liquidation, can therefore be written as:

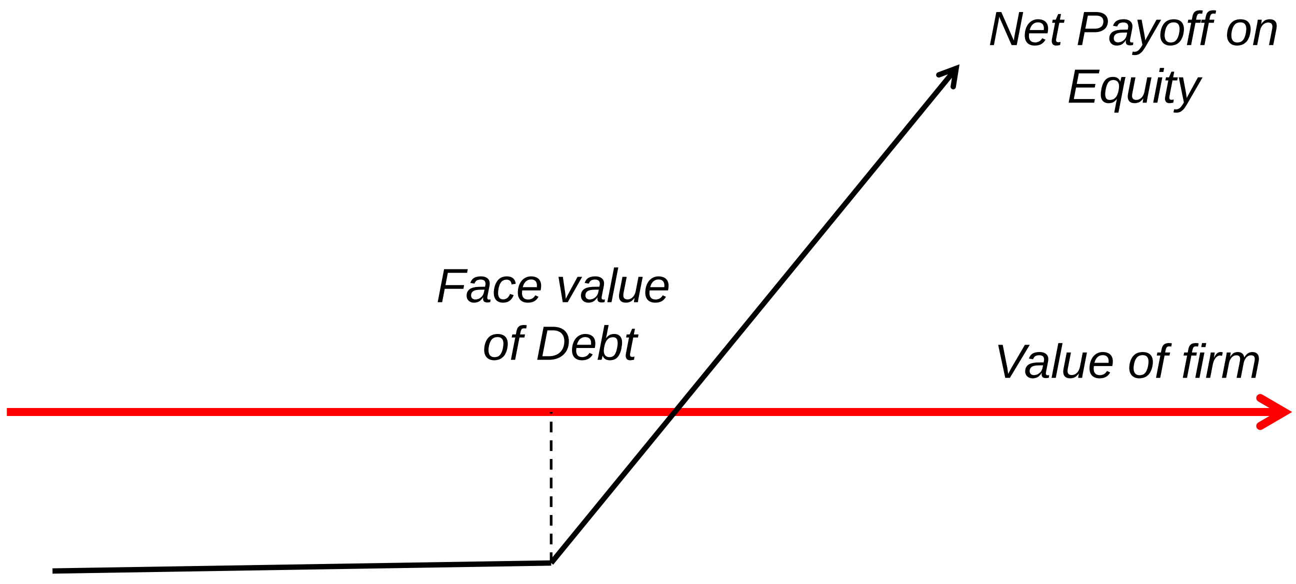
$$\text{Payoff to equity on liquidation} \begin{cases} V - D & \text{if} \quad V > D \\ 0 & \text{if} \quad V \leq D \end{cases}$$

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 $$\begin{cases} V - D & \text{if } \quad V > D \\ 0 & \text{if } \quad V \leq D \end{cases}$$

Payoff Diagram for Liquidation Option



Option Pricing Applications in Equity Valuation

Adapt the Black-Scholes option pricing model to value companies through the so called real options.

$$C(S,t) = N(d_1)S - N(d_2)Ke^{-r(T-t)}$$

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}} \qquad d_2 = \frac{\ln\left(\frac{S}{K}\right) + \left(r - \frac{\sigma^2}{2}\right)(T-t)}{\sigma\sqrt{T-t}}$$

$$d_2 = d_1 - \sigma\sqrt{T-t}$$

Rearranging the Black-Scholes option pricing model

$$C(S,t) = N(d_1)S - N(d_2)Ke^{-r(T-t)}$$

Symbol	**Option Pricing**	**Real Option pricing**
C	Call Price	Value of Firm's Equity
S	Spot Price of the underlying Asset	Current Firm value
T – t	Time to maturity of the option	Time to Maturity on Debt
σ	Volatility in log Returns of the Underlying Asset	Standard Deviation of Firm Value
K	Strike or Exercise Price	Total face Value of Debt
r	Continuous riskless interest Rate	Continuous Riskless Interest Rate

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 (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?

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 interest 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:

$$d_1 = 1.5994 \qquad N(d_1) = 0.9451$$

$$d_2 = 0.3345 \qquad N(d_2) = 0.6310$$

Value of the call = $100\ (0.9451) - 80\ e^{(-0.10)(10)}\ (0.6310)$ = \$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 impact of decrease in Value

Assume that the value of this firm drops to half (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 slide).

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

c) It will be worth more than $ 25.94 million.

This firm is in trouble, since it owes (at least in face value terms) more than it owns.
The equity in the firm will still have value, however.

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%

Based upon these inputs, the Black-Scholes model provides the following value for the call:

$$d_1 = 1.0515 \qquad N(d_1) = 0.8534$$

$$d_2 = -0.2135 \qquad N(d_2) = 0.4155$$

Value of the call = 50 (0.8534) - 80 $e^{(-0.10)(10)}$ (0.4155) = $30.44 million

Value of the outstanding debt = $50 - $30.44 = $19.56 million

Interest rate on debt = ($ 80 / $19.56)$^{1/10}$ -1 = 15.13%

The value of equity decline, due the option characteristics of equity.

This explain why stock in firms, which are in Chapter 11 (Bankruptcy) still has value.

Implications

Equity have value, even if the value of the firm falls well below the face value of the outstanding debt.

Such a firm is in distressed, but that does not mean that its equity is worthless.

A out-of-the-money traded options has value because of the possibility that the value of the underlying asset may increase above the exercise price in the remaining lifetime of the option. Equity will have value because of the time premium on the option (the time until the bonds mature and come due) and the possibility that the value of the assets may increase above the face value of the bonds before they come due.

The inputs

Input	Estimation Process
Value of the Firm	Cumulate market values of equity and debt Value the assets in place using FCFF and WACC Use cumulated market value of assets, if traded
Variance in Firm Value	If stocks and bonds are traded: $\sigma^2 \text{firm} = w_E^2\ \sigma^2_E + w_D^2\ \sigma^2_D + 2\ w_E\ w_D\ \rho_{ED}\ \sigma_E \sigma_D$ σ^2_E = variance in the stock price σ^2_D = variance in the bond price w_E = Market Value weight of Equity w_D = Market Value 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 If not available, use weighted maturity