Chapter 28

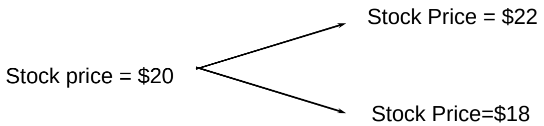
Real Options

An Alternative to the NPV Rule for Capital Investments

- Define stochastic processes for the key underlying variables and use risk-neutral valuation
- This approach (known as the real options approach) is likely to do a better job at valuing growth options, abandonment options, etc than NPV

The Problem with using NPV to Value Options

- Consider the example from Chapter 10



- Suppose that the expected return required by investors in the real world on the stock is 16%. What discount rate should we use to value an option with strike price $21?

Correct Discount Rates are Counter-Intuitive

- Correct discount rate for a call option is 42.6%
- Correct discount rate for a put option is –52.5%

General Approach to Valuation

- We can value any asset dependent on a variable θ by
  - Reducing the expected growth rate of θ by λs where λ is the market price of θ-risk and s is the volatility of θ
  - Assuming that all investors are risk-neutral

Extension to Many Underlying Variables

- When there are several underlying variable θ_i we reduce the growth rate of each one by its market price of risk times its volatility and then behave as though the world is risk-neutral
- Note that the variables do not have to be prices of traded securities

Estimating the Market Price of Risk (equation 28.7, page 665)

Schwartz and Moon Have Applied the Real Options Approach to Valuing Amazon.com

- They estimated stochastic processes for the company's sales revenue and its revenue growth rate.
- They estimated the market prices of risk and other key parameters (cost of goods sold as a percent of sales, variable expenses as a percent of sales, fixed expenses, etc.)
- They used Monte Carlo simulation to generate different scenarios in a risk-neutral world.
- The stock price is the present value of the net cash flows discounted at the risk-free rate.

Commodity Prices

- Futures prices can be used to define the process followed by a commodity price in a risk-neutral world.
- We can build in mean reversion and use a process for constructing trinomial trees that is analogous to that used for interest rates in Chapter 23

Example (page 671)

A company has to decide whether to invest \$15 million to obtain 6 million barrels of oil at the rate of 2 million barrels per year for three years. The fixed operating costs are \$6 million per year and the variable costs are \$17 per barrel. The spot price of oil \$20 per barrel and 1, 2, and 3-year futures prices are \$22, \$23, and \$24, respectively. The risk-free rate is 10% per annum for all maturities.

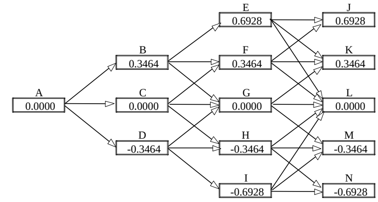
The Process for Oil

We assume that this is

$$d\ln(S)=[\theta(t)-a\ln(S)]\,dt+\sigma\,dz$$

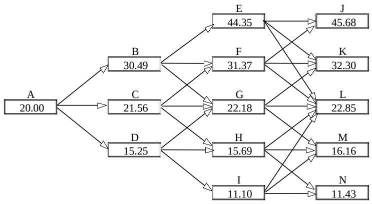
Where a=0.1 and σ=0.2

Tree Assuming $\theta(t)$=0; Fig 28.1



Node	A	B	C	D	E	F	G	H	I
p_u	0.1667	0.1217	0.1667	0.2217	0.8867	0.1217	0.1667	0.2217	0.0867
p_m	0.6666	0.6566	0.6666	0.6566	0.0266	0.6566	0.6666	0.6566	0.0266
p_d	0.1667	0.2217	0.1667	0.1217	0.0867	0.2217	0.1667	0.1217	0.8867

Final Tree for Oil Prices; Fig 28.2



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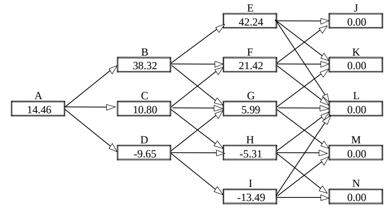
Valuation of Base Project; Fig 28.3



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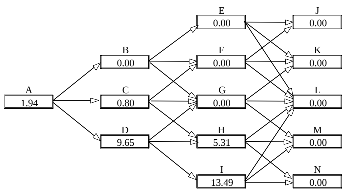
Valuation of Option to Abandon; Fig 28.4 (No Salvage Value; No Further Payments)



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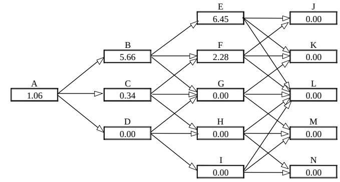
p_d	0.1667	0.2217	0.1667	0.1217	0.0867	0.2217	0.1667	0.1217	0.8867

Value of Expansion Option; Fig 28.5 (Company Can Increase Scale of Project by 20% for $2 million)



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