Chapter 23
Options and Corporate Finance: Applications and Extensions

- **Executive Stock Options**
- **Valuing a Start Up**
- **The Binomial Model**
- **Shutdown and Reopening Decisions**
- **Summary and Conclusions**

Executive Stock Options

- Executive Stock Options exist to align the interests of shareholders and managers.
- Executive Stock Options are call options (technically warrants) on the employer's shares.
  - Inalienable
  - Typical maturity is 10 years.
  - Typical vesting period is 3 years.
  - Most include implicit reset provision to preserve incentive compatibility.
- Executive Stock Options give executives an important tax break: grants of at-the-money options are not considered taxable income. (Taxes are due if the option is exercised.)

Valuing Executive Compensation

- FASB allows firms to record zero expense for grants of at-the-money executive stock options.
- However the economic value of a long-lived call option is enormous, especially given the propensity of firms to reset the exercise price after drops in the price of the stock.
- Due to the inalienability, the options are worth less to the executive than they cost the company.
  - The executive can only *exercise*, not *sell* his options. Thus he can never capture the speculative value—only the intrinsic value.
- This "dead weight loss" is overcome by the incentive compatibility for the grantor.

Top Stock Option Grants

Company	CEO	Stock Option Award
Citigroup, Inc.	Sanford Weill	$351,319,000
American Express	Harvey Golub	$134,102,000
Cisco Systems, Inc.	John Chambers	$132,100,000
Bank of America	Hugh McColl Jr.	$104,300,000
Honeywell Inc.	Michael Bosignore	$121,496,000
ALCOA	Paul O'Neill	$96,353,000

Example of Valuing Executive Compensation Using Black-Scholes

- Stetson Corp. president has option on 1 million shares.
- The options are at the money and the current stock price is $40.
- The risk-free rate is 5% and the options expire in 4 years. The standard deviation in Stetson stock has been 30%.
- What is the value of her options?

Example of Valuing Executive Compensation Using Black-Scholes

$S = \$40$, $K_{RF} = 5\%$, $E = \$40$, $SD = 30\%$, $T = 4$ yrs

$$C_0 = S \times N(d_1) - Ee^{-rT} \times N(d_2)$$

$$d_1 = \frac{\ln(S/E) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} \qquad d_2 = d_1 - \sigma\sqrt{T}$$

Example of Valuing Executive Compensation Using Black-Scholes

$$C_0 = S \times N(d_1) - Ee^{-rT} \times N(d_2)$$

$N(d_1) =$

$N(d_2) =$

Total value of options =

Valuing a Start-Up

- An important option is the option to expand.
- Imagine a **start-up firm**, Campusteria, Inc. which plans to open private dining clubs on college campuses.
- The test market will be your campus, and if the concept proves successful, expansion will follow nationwide.
- Nationwide **expansion** will occur in **year four**.
- The **start-up cost** of the test dining club is only **$30,000** (this covers leaseholder improvements and other expenses for a vacant restaurant near campus).
- Assume 10% cost of capital.

Campusteria *pro forma* income statement

Investment	Year 0	Years 1-4
Revenues		$60,000
Variable Costs		($36,000)
Fixed Costs		($18,000)
Depreciation		($7,500)
Pretax profit		($1,500)
Tax shield 34%		$510
Net Profit		–$990
Cash Flow	–$30,000	$6,510

We plan to sell 25 meal plans at $200 per month with a 12-month contract.

Variable costs are projected to be $3,000 per month.

Fixed costs (lease payment) are projected to be $1,500 per month.

We can depreciate our capitalized leaseholder improvements.

CF adds back deprec.

Valuing a Start-Up

- Note that while the Campusteria test site has a negative NPV, we *are* close to our break-even level of sales.
- If we expand, we project opening 20 Capusterias in year four.
- The value of the project is in the option to expand.
- We will use the Black-Scholes option pricing model to value this option

Valuing a Start-Up with Black-Scholes

The Black-Scholes Model is:

$$C_0 = S \times N(d_1) - Ee^{-rT} \times N(d_2)$$

Where

C_0 = the value of the option at time $t = 0$

r = the risk-free interest rate.

$$d_1 = \frac{\ln(S/E) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$$

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

The Black-Scholes Model allows us to value options in the real world just as we have done in the 2-state world.

Valuing a Start-Up with Black-Scholes

We need to find the value of a four-year call option on chain with an exercise price of

The interest rate available is r = 10%.

The option maturity is four years.

The standard deviation of the underlying asset is 30% per annum.

The current value of the underlying assets is:

Valuing a Start-Up with Black-Scholes

First calculate d_1 and d_2

$$d_1 = \frac{\ln(S/E) + (r + .5\sigma^2)T}{\sigma\sqrt{T}}$$

Then,

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

Valuing a Start-Up with Black-Scholes

$$C_0 = S \times N(d_1) - Ee^{-rT} \times N(d_2)$$

$N(d_1) =$

$N(d_2) =$

Total value = NPV of 1st + value of option

The Option to Delay: Example

- Consider a project, which can be undertaken in any of the next 4 years.
- Discount rate is 10 percent.
- Present value of the benefits (all cash flows) at the time the project is launched remain constant at $25,000
- Since T_0 costs are declining, the NPV at the time of launch increases.
- When is the best time to launch the project?

The Option to Delay: Example

Year Project Starts	*Cost to start in this year*	*Total PV of CFs*	NPV_t	NPV_0
0	$ 20,000	$ 25,000	$ 5,000	
1	$ 18,000	$ 25,000	$ 7,000	
2	$ 17,100	$ 25,000	$ 7,900	
3	$ 16,929	$ 25,000	$ 8,071	
4	$ 16,760	$ 25,000	$ 8,240	

- NPV_t is the NPV the year the project is launched.
- This NPV must be discounted back to T_0.
- When is the best time to start the project?
- The best time to launch the project is in year 2—this schedule yields the highest NPV when judged today.

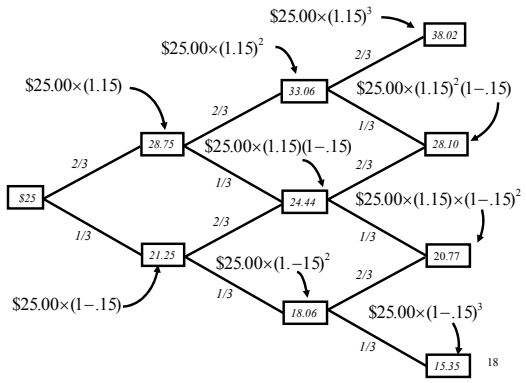
The Binomial Model

- The binomial option pricing model is an alternative to the Black-Scholes option pricing model.
- In some cases, it is a superior alternative.
- For example if you have *path dependency* in your option payoff, you must use the binomial option pricing model.
  - Path dependency is when the path you follow to price the asset is important.
  - One example of a path dependent security is a "no regret" call option where the exercise price is the lowest price of the stock during the option life.

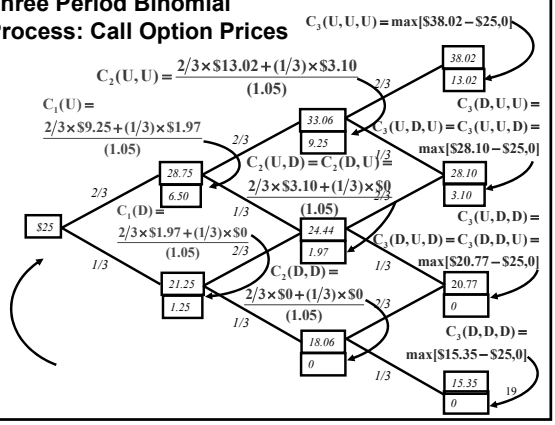
Three Period Binomial Option Pricing Example

- **You can do the binomial model for any number of periods, the more the better.**
- **Find the value of a three-period at-the-money call option written on a $25 stock that can go up or down 15 percent each period when the risk-free rate is 5 percent.**
- **The probability of up is 2/3 and down is 1/3.**

Three Period Binomial Process: Stock Prices



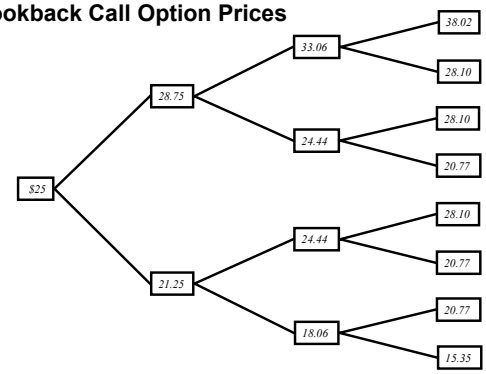
Three Period Binomial Process: Call Option Prices



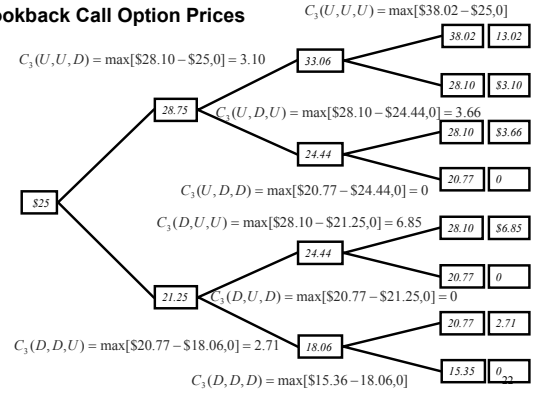
Valuation of a Lookback Option

- **When the stock price falls due to the stock market declining, the board of directors may reset the exercise price of executive stock options.**
- **To see how this reset provision adds value, let's price that same three-period call option (exercise price initially $25) with a reset provision.**
- **Notice that the exercise price of the call will be the smallest value of the stock price depending upon the path followed by the stock price to get there.**

Three Period Binomial Process: Lookback Call Option Prices



Three Period Binomial Process: Lookback Call Option Prices



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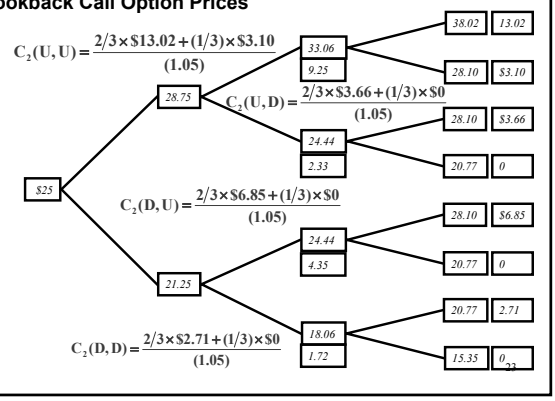

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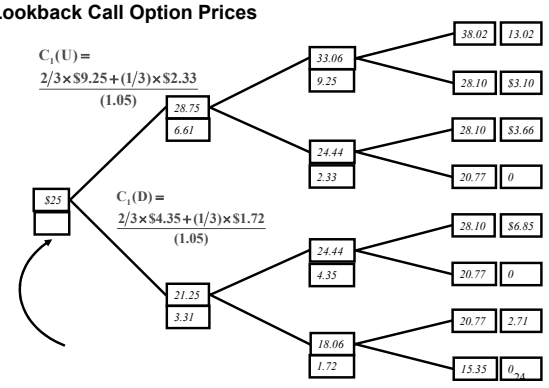


Excel Applications of the Binomial OPM

REAL OPTIONS Using The Binomial Model

Call Continuous

Inputs		Outputs	
Option Type: 1=Call, 0=Put	1	Time / Period	0.13
Asset Value Now (V)	$5.30	Riskfree Rate / Period	0.75%
Asset Value Std Dev (σ)	30.00%	Up Movement / Period	11.19%
Riskfree Rate - Annual (r)	6.00%	Down Movement / Period	-10.06%
Exercise Price (E)	$5.70	Risk Neutral Probability	50.89%
Time To Maturity - Yrs (T)	1.00		
Number of Periods	8		
Annualization Convention			
1=Discrete, 0=Continuous	0		
Land Cost = Real Opt Cost	$0.40		

	Now								Maturity
Period	0	1	2	3	4	5	6	7	8
Time	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875	1.000
Stock	$5.30	$5.89	$6.55	$7.29	$8.10	$9.01	$10.02	$11.14	$12.38
		$4.77	$5.30	$5.89	$6.55	$7.29	$8.10	$9.01	$10.02
			$4.29	$4.77	$5.30	$5.89	$6.55	$7.29	$8.10
				$3.86	$4.29	$4.77	$5.30	$5.89	$6.55
					$3.47	$3.86	$4.29	$4.77	$5.30
						$3.12	$3.47	$3.86	$4.29
							$2.80	$3.12	$3.47
								$2.52	$2.80
									$2.27
Call	$0.62	$0.92	$1.34	$1.89	$2.59	$3.43	$4.40	$5.48	$6.68
		$0.31	$0.50	$0.78	$1.19	$1.76	$2.49	$3.35	$4.32
			$0.12	$0.21	$0.37	$0.63	$1.03	$1.63	$2.40
				$0.03	$0.06	$0.11	$0.22	$0.43	$0.85
					$0.00	$0.00	$0.00	$0.00	$0.00
						$0.00	$0.00	$0.00	$0.00
							$0.00	$0.00	$0.00
								$0.00	$0.00
									$0.00
NPV Using Binomial	$0.22								

Shutdown and Reopening Decisions

- Can easily be seen as options.
- The "Woe is Me" gold mine is currently closed.
- The firm is publicly held and trades under the ticker WOE.
- The firm has no debt and has assets of around $30 million.
- The market capitalization is $240 million
- What could possibly explain why a firm with $30 million in assets and a closed gold mine that is producing no cash flow at all has this kind of market capitalization?
- Options. This firm has many options.

Shutdown and Reopening Decisions

- The "Woe is Me" gold mine is currently closed.
- Call on the price of gold.
- Exercise price is $350 extraction cost.
- Exercise fee of $2 million to open mine.
- Closing fee of $1 million when abandoned.
- No maturity date.
- Solved with a simulation using the binomial approach.
- Best pricing option: open mine when gold is $400 and close mine when gold is $140, for value of $1.47 billion (Table 23.6).

Discounted Cash Flows and Options

- We can calculate the market value of a project as the sum of the NPV of the project without options and the value of the managerial options implicit in the project.

$$\mathbf{MV = NPV + Options}$$

- A good example would be comparing the desirability of a specialized machine versus a more versatile machine. If they both cost about the same and last the same amount of time the more versatile machine is more valuable because it comes with options.

The Option to Abandon: Example

- Suppose that we are drilling an oil well. The drilling rig costs $300 today and in one year the well is either a success or a failure.
- The outcomes are equally likely. The discount rate is 10%.
- The *PV* of the successful payoff at time one is $575.
- The *PV* of the unsuccessful payoff at time one is $0.

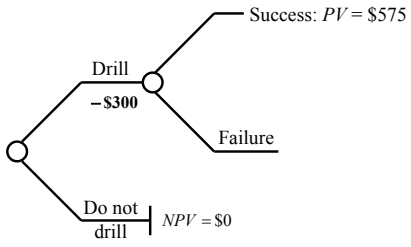
The Option to Abandon: Example

Traditional NPV analysis would indicate rejection of the project.

$$\text{Expected payoff} = \left(\text{Prob. success} \times \text{Payoff given success}\right) + \left(\text{Prob. failure} \times \text{Payoff given failure}\right)$$

The Option to Abandon: Example

Traditional NPV analysis overlooks the option to abandon.



The firm has two decisions to make: drill or not, abandon or stay.

The Option to Abandon: Example

- When we include the value of the option to abandon, the drilling project should proceed:

$$\text{Expected payoff} = \left(\text{Prob. success} \times \text{Payoff given success}\right) + \left(\text{Prob. failure} \times \text{Payoff given failure}\right)$$

Valuation of the Option to Abandon

- Recall that we can calculate the market value of a project as the sum of the NPV of the project without options and the value of the managerial options implicit in the project.

$$\text{MV} = \text{NPV} + \text{Options}$$

Enron's Inefficient Plants

- In 1999 Enron planned to open gas-fired power plants in Mississippi and Tennessee. These plants were expected to sit idle most of the year, and, when operated to produce electricity at a cost of at least 50 percent higher than the most efficient state-of-the-art facility.
- Enron was buying what?

- Having a plant that was only economic to operate a few weeks a year was a positive NPV investment—when you include the value of that option.