

## 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**

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### 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.)

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### 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.

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### 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

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### 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?

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### Example of Valuing Executive Compensation Using Black-Scholes

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

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

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

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

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### 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 =

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### 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.

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### 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.

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### 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

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### 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.

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### 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:

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## 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,

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

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## 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 1<sup>st</sup> + value of option

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## 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?

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## The Option to Delay: Example

Year Project Starts	Cost to start in this year	Total PV of CFs	NPV <sub>t</sub>	NPV <sub>0</sub>
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<sub>t</sub> 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.

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## 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.

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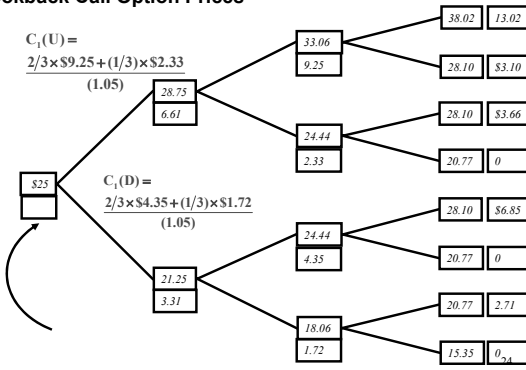
## Three Period Binomial Option Pricing Example

- 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.

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### Three Period Binomial Process: Lookback Call Option Prices



### Excel Applications of the Binomial OPM

REAL OPTIONS Using The Binomial Model									
Call					Continuous				
1	Inputs	Outputs							
2	Option Type: 1=Call, 0=Put	1	Time / Period	0.13					
3	Asset Value Now (C)	\$5.30	Riskfree Rate / Period	0.75%					
4	Asset Value 2nd Exp. (D)	20.00%	Up Movement / Period	11.19%					
5	Riskfree Rate - Annual (E)	6.00%	Down Movement / Period	-10.06%					
6	Exercise Price (F)	\$5.75	Risk Neutral Probability	50.00%					
7	Time To Maturity - Yrs (T)	1.00							
8	Number of Periods	8							
9	Amortization Convention	0							
10	Indifference, Discontinuous	0							
11	Largest Cost = Final Opt Cost	\$0.40							
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### 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.

$$MV = NPV + Options$$

- 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

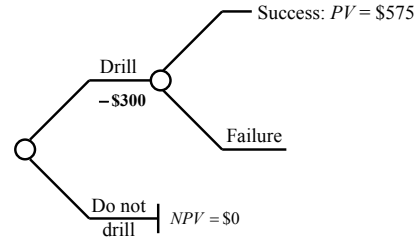
Traditional NPV analysis would indicate rejection of the project.

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

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## 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:

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

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## 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.

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

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## 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.

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