SESSION 20: THE ESSENCE OF REAL OPTIONS
Underlying Theme: Searching for an Elusive Premium

- Traditional discounted cashflow models under estimate the value of investments, where there are options embedded in the investments to
  - Delay or defer making the investment (delay)
  - Adjust or alter production schedules as price changes (flexibility)
  - Expand into new markets or products at later stages in the process, based upon observing favorable outcomes at the early stages (expansion)
  - Stop production or abandon investments if the outcomes are unfavorable at early stages (abandonment)
- Put another way, real option advocates believe that you should be paying a premium on discounted cashflow value estimates.
A bad investment...

Today

Success

Failure

1/2

1/2

+100

-120
Becomes a good one...

Now

2/3

1/3

+20

2/3

1/3

-20 STOP

-100

+80

Aswath Damodaran
Three Basic Questions

- When is there a real option embedded in a decision or an asset?
- When does that real option have significant economic value?
- Can that value be estimated using an option pricing model?
When is there an option embedded in an action?

- An option provides the holder with the right to buy or sell a specified quantity of an underlying asset at a fixed price (called a strike price or an exercise price) at or before the expiration date of the option.
- There has to be a clearly defined underlying asset whose value changes over time in unpredictable ways.
- The payoffs on this asset (real option) have to be contingent on an specified event occurring within a finite period.
Payoff Diagram on a Call

Price of underlying asset

Strike Price

Net Payoff

Price of underlying asset
Payoff Diagram on Put Option
When does the option have significant economic value?

- For an option to have significant economic value, there has to be a restriction on competition in the event of the contingency.
  - In a perfectly competitive product market, no contingency, no matter how positive, will generate positive net present value.

- At the limit, real options are most valuable when you have exclusivity - you and only you can take advantage of the contingency. They become less valuable as the barriers to competition become less steep.

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Determinants of option value

- **Variables Relating to Underlying Asset**
  - Value of Underlying Asset; as this value increases, the right to buy at a fixed price (calls) will become more valuable and the right to sell at a fixed price (puts) will become less valuable.
  - Variance in that value; as the variance increases, both calls and puts will become more valuable because all options have limited downside and depend upon price volatility for upside.
  - Expected dividends on the asset, which are likely to reduce the price appreciation component of the asset, reducing the value of calls and increasing the value of puts.

- **Variables Relating to Option**
  - Strike Price of Options; the right to buy (sell) at a fixed price becomes more (less) valuable at a lower price.
  - Life of the Option; both calls and puts benefit from a longer life.

- **Level of Interest Rates;** as rates increase, the right to buy (sell) at a fixed price in the future becomes more (less) valuable.
When can you use option pricing models to value real options?

- The notion of a replicating portfolio that drives option pricing models makes them most suited for valuing real options where:
  - The underlying asset is traded - this yield not only observable prices and volatility as inputs to option pricing models but allows for the possibility of creating replicating portfolios.
  - An active marketplace exists for the option itself.
  - The cost of exercising the option is known with some degree of certainty.

- When option pricing models are used to value real assets, we have to accept the fact that:
  - The value estimates that emerge will be far more imprecise.
  - The value can deviate much more dramatically from market price because of the difficulty of arbitrage.
Choices of Models

- **Black-Scholes Model:** Makes restrictive assumptions about volatility (fixed over option life) and early exercise (none) and price process for underlying asset (no jumps), but arrives at a parsimonious model where the option value is a function of only 6 observable inputs:
  - The current price of the underlying asset
  - The strike price on the option
  - The life of the option
  - The variance in the price of the underlying assets
  - The riskless rate for the option life
  - Dividends over the life of the option (not in original Black Scholes)

- **Binomial Model:** This is a more general and less restrictive model but it requires a great deal more data on how the price of the underlying asset will evolve over time.
Most practitioners who use option pricing models to value real options argue for the binomial model over the Black-Scholes and justify this choice by noting that

- Early exercise is the rule rather than the exception with real options
- Underlying asset values are generally discontinuous.

If you can develop a binomial tree with outcomes at each node, it looks a great deal like a decision tree from capital budgeting. The question then becomes when and why the two approaches yield different estimates of value.
Key Tests for Real Options

- Is there an option embedded in this asset/decision?
  - Can you identify the underlying asset?
  - Can you specify the contingency under which you will get payoff?

- Is there exclusivity?
  - If yes, there is option value.
  - If no, there is none.
  - If in between, you have to scale value.

- Can you use an option pricing model to value the real option?
  - Is the underlying asset traded?
  - Can the option be bought and sold?
  - Is the cost of exercising the option known and clear?