LET’S GET REAL!

Managing Strategic Investment in an Uncertain World:
A Real Options Approach
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Let’s Get Real!

Roadmap

- Financial Options
- Real Options
- Examples
- Strategy and Real Options
Why An Options Perspective?

- Overcome shortcomings of ordinary NPV analysis
- Establish common ground for uniting capital budgeting and strategic planning
- A new way of thinking
Shortcomings of NPV Analysis

– Passive, assumes business as usual with no management intervention
– Strategic factors ignored
– NPV understates value
  ◆ Operating flexibility ignored
  ◆ Valuable follow-on investment projects ignored
– Many investments have uncertain payoffs that are best valued with an Options approach
– Risk-adjusted discounted rates problem
Valuation Problems: A Taxonomy

Balance Sheet

**Uses**
1. Operations (Assets in place)
2. Opportunities (real options)

**Sources**
- Debt claims
- 3. Equity Claims

Real Asset Markets

Financial Asset Markets

Investors
Nobel Prize-winning work of Black-Merton-Scholes

Applications for real (non-financial) assets

Extensions for how real assets are managed

What is the value of a contract that gives you the right, but not the obligation to purchase a share of IBM at $100 six months from now?

What is the value of starting a project that gives you the right, but not the obligation, to launch a sales program at a cost of $7M six months from now?

We operate in a fast changing and uncertain market. How can we better make strategic decisions, manage our investments, and communicate our strategy to Wall St?
Financial Options
Call Option Profit/Loss Profile

- Exercise Price (X) = 100
- Initial Option Price = 4

104 = Break-even

Price of Underlying Asset at Expiration
Characteristic Payoff of a Call Option

Payoff

Exercise Price

Asset price
Option Value: Dead vs Alive

- **Live Option Value**
- **Dead Option Value**
- **Exercise Price**
- **Asset Price**

**Payoff**

**Exercise Price**
Determinants of Option Value

- Stock Price - the higher the price of the underlying stock, the greater the option’s intrinsic value
- Exercise Price - the higher the exercise price, the lower the intrinsic value
- Interest Rates - the higher interest rates, the more valuable the call option
- Volatility of the Stock Price - the more volatile the stock price, the more valuable the option
- Time to Maturity - call options increase in value the more time there is remaining to maturity
Option Valuation
Out of the Ivory Tower!

- Binomial Option Pricing Model
  - Portfolio Replication Method
  - Risk Neutral Method

- Black-Scholes Model
Real Options: Link between Investments and Black-Scholes Inputs

- PV of project
- Free Cash Flow
- Outlay to acquire project assets
- Time the decision can be deferred
- Time value of money
- Risk of project assets
- Stock price
- Exercise price
- Time to expiration
- Risk-free rate
- Variance of returns
Real Options Defined

- Nobel Prize-winning work of Black-Merton-Scholes
- Applications for real (nonfinancial) assets
- Extensions for how real assets are managed

- What is the value of a contract that gives you the right, but not the obligation to purchase a share of IBM at $100 six months from now?
- What is the value of starting a project that gives you the right, but not the obligation, to launch a sales program at a cost of $7M six months from now?
- We operate in a fast changing and uncertain market. How can we better make strategic decisions, manage our investments, and communicate our strategy to Wall St?
Investment Decisions

1. Irreversibility
2. Uncertainty
3. Flexibility
   - Timing
   - Scale
   - Operations
Investment Decisions

1 & 2 → 3 is valuable

1 & 2 & 3 → Option (flexibility) valuation
Option Value (a.k.a. flexibility)

- Can be large
- Sensitive to uncertainty
- Explains why firms appear to underinvest
Flexibility: Investments have uncertainty and decision-points

Fund          First      Develop      Test      Product      Sales      Brand      Retire
Research     Results     More       Market     Launch     Extension     Product

- Your decision
- New Information
What types of investments does this describe?

- R&D related businesses - biotech, pharmaceuticals, entertainment.
- Natural resource businesses - extractive industries.
- Consumer product companies
- High-tech companies (IT platforms, software)
- Capital intensive businesses
- Real estate
Frequently Encountered Real Options

- **Timing**  now or later; “wait and learn”
- **Exit**  limiting possible future losses by exiting now
- **Flexibility**  today’s value of the future opportunity to switch
- **Operating**  the value of temporary shutdown
- **Learning**  value of reducing risk to make better decision
- **Growth**  today’s value of possible future payoffs
Growth Options

- Valuable new investment opportunities ("follow-on projects") can be viewed as call options on assets

- Examples:
  - Exploration
  - Capacity expansion projects
  - New product introductions
  - Acquisitions
  - Advertising outlays
  - R&D outlays
  - Commercial development
Investment Project Options: Examples

- **Growth Option ("Follow-On Projects")**
  - NorTel commits to production of digital switching equipment specially designed for the European market. The project has a negative NPV, but is justified by the need for a strong market position in this rapidly growing, and potentially very profitable, market.

- **Switching Option**
  - Atlanta Airways buys a jumbo jet with special equipment that allows the plane to be switched quickly from freight to passenger use or vice versa.

- **Timing Option**
  - Georgia Power postpones a major base plant expansion. The expansion has positive NPV, but top management wants to get a better fix on product demand before proceeding.
Investment Project Options: Examples

- **Fuel Switching**
  - A power plant has the capacity of burning oil or gas. Mgrs can decide which fuel to burn in light of fuel prices prevailing in the future.

- **Shut-Down Option**
  - A power plant can be shut down temporarily. Mgt. can decide whether or not to operate the plant in light of the avoided cost of power prevailing in the future.

- **Investment Timing**
  - Mgt. can invest in new capacity now or defer when more information on demand growth and fuel prices is available.
Which is a closer analogy to these types of projects?

Bond ? or Option ?
Standard NPV analysis treats projects like bonds

Average promised cash flow

up-front investment
NPV ignores valuable flexibility
A Numerical Example

- $100 investment, then 50% chance of earning $50/year for four years and 50% chance of earning nothing per year.
  - NPV of “average” cash flow = ($20)

- $10 investment, then additional $90 investment, only if you find out that you can earn $50/year for the next four years (50% likely)
  - NPV of cash flow, including option = $22
Certainty is a narrow path!
What Flexibility Does the Holder of an Option Have?

- To walk away from the contract, if it is not in his favor.
- To exercise the right to buy (or sell), if it is in his favor.
- To accelerate the decision, if that makes sense.
Flexibility = Active Management
\[ \text{NPV}^' = \text{NPV}_{\text{passive}} + \text{Option Value} \]
Option Value: dead and live

“S - X” Intrinsic Value of Option

Live Option Value

Dead Option Value

NPV

“X” Investment

$S_{avg}$

“S” Value of Developed Project
When options really matter

Out of the Money

At the Money

In the Money

“S - X”

“S”
When options really matter

\[ \text{Out of the Money} \]

\[ \text{At the Money} \]

\[ \text{In the Money} \]

\[ S - X \]
How do real options increase value?

- Real options allow managers to avoid negative project cash flows or magnify positive project cash flows.
  - Increases size of expected cash flows.
  - Decreases risk of expected cash flows.
Real options are more valuable if:
- They have a long time until you must exercise them.
- The underlying source of risk is very volatile.
The flexibility value comes from the ability to respond to information that may be received in the future. The greater the likelihood that this new future information will elicit a managerial response and alter the course of a project, the more value the option will have.

In every scenario flexibility value is greatest when the project’s value without flexibility is close to break even.
“I’m sold, but what do I do?”
Technique

- First step is framing the question
- Next, there are a variety of techniques
  - Force-fit problem into stylized model, like Black-Scholes.
  - Create customized model to recognize the complicated set of managerial choices
- Finally, you have to work through some important nuances.
Framing the question is critical

- Identifying the optionality
  - What is the flexibility?
  - Is it like a call? A put? A more complicated structure?

- Scope out the importance

- Is this flexibility that is likely to be important to you? Is the project “marginal” under NPV, but there is phased investment and learning?
Application Problems

1. Underlying asset may not be traded; difficult to estimate value and variance of underlying asset
2. Price of the asset may not follow a continuous process
3. Variance may not be known and may change over the life of the option
4. Exercise may not be instantaneous
5. Some real options are complex and their exercise creates other options (compound) or involve learning (learning options)
6. More than one source of variability (rainbow options)
R&D and Options Thinking

- Investing in an R&D project is like buying a call option to make further investments.
- If initial investigations justify a further investment, the company will invest further.
- If not, abort project.
- Value of the project should reflect these investment contingencies – the option value is higher than that which would be calculated if all future investments were locked in.
- Options thinking provides an outcome’s uncertainty value.
Option Analysis at Merck

- Project Gamma - new line of business that required the acquisition of appropriate technologies from a small biotech company called Gamma
- Merck would make a $2 million payment to Gamma over a period of three years
- Merck would pay royalties to Gamma should the product ever come to market
- Merck had the option to terminate the agreement at any time if dissatisfied with the research
Option Analysis at Merck

- Merck’s finance group used the Black-Scholes option-pricing model
  
  - *Exercise price* = capital investment to be made 2 years hence
  - *Stock price* = present value of cash flows from the project
  - *Time to expiration* = varied over two, three and four years (with market entry unfeasible after four years)
  - *Volatility* = standard deviation of returns for typical biotech stocks
  - *Risk-free interest rate* = U.S. Treasury rate over the two to four year period
Valuing a New Venture with Real Options

- Product development 2yrs, $0.5M/quarter
- Product launch in 2 yrs, $12M
- Value of a sustainable business $22M \( (M/S \times \text{Sales}) \)
- NPV @ 21% after 2 years is negative $0.23m
- NPV ignores valuable option; launch only if profitable
- By investing in early-stage development, you are purchasing an option to launch the product
Business Plan

Spend $12M on Market Launch

If Launch, obtain value of established participant $22M

Raise $4M

spend $0.5M/quarter on product development

Year 1
Year 2
Year 3

Spend $12M on Market Launch
But there is no obligation to launch the product, only an option

- NPV has 2 parts
  - “hardwired” investment schedule
  - single roll of the dice on revenue
- Recognizing the option to launch
  - multitude of outcomes
  - optimal response to each outcome, including the no launch decision
# Inputs to the Black-Scholes Model

## Option to Launch

<table>
<thead>
<tr>
<th>The option to launch</th>
<th>Call option on a stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current estimate of PV revenues</td>
<td>$S$ Stock Price</td>
</tr>
<tr>
<td>Cost of launch</td>
<td>$X$ Exercise price</td>
</tr>
<tr>
<td>Launch date</td>
<td>$T$ Exercise date</td>
</tr>
<tr>
<td>Time value of money</td>
<td>$r$ Risk-free rate</td>
</tr>
<tr>
<td>Volatility of value</td>
<td>$\sigma$ Std dev’n return on the stock</td>
</tr>
</tbody>
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Amazon.com: Building Value Through Options
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DCF books
DCF Music
DCF Video
DCF books
DCF Music
DCF books
DCF books
Value of whole strategy

\[
\text{PV} \left\{ \begin{array}{l}
\text{Product} + \text{call} \left\{ \text{1st expansion} + \text{call} \left( \text{2nd expansion} \right) \right\} \\
\text{Introduction} + \text{value} \left\{ \text{option} + \text{value \ option} \right\}
\end{array} \right\}
\]
Conclusion:
The Real Value of Real Options

- Reshaping our thinking about strategic investments under uncertainty
- Communicating value internally and to the financial markets
- Making strategic decisions that increase shareholder value
Conclusion: The Real Value of Real Options

- Growth related options significantly undervalued by traditional tools
- Need to change the frame of reference:
  - Face the uncertainty
  - Identify the options
  - Is the value of the option > cost of acquiring or maintaining it?
  - What does it take to keep the option alive and valuable?
- Option-based decision-making links strategy and valuation
Strategic Planning = Options Management

- Acquiring Options
  - Investing in R&D
  - Product Design
  - Loss-Leaders

- Abandoning Options
  - Abandon options far “out of the money”

- Exercise valuable options at the right time
Two Cultures of Competition

Old Economy

Operations-based
- Optimize operations
- Hierarchies
- Control - Budget

DCF-based
- Optimization
- Strategic planning
  A.k.a. strategic programming

New Economy

Knowledge-based
- Find the next big thing
- Flat
- Free rein

ROV-based
- Adaptability

Strategic thinking
- Synthesis, creativity
- Intuitive

Old Economy → New Economy
Readings

THE END

Ready for questions!
Expanded NPV = Static NPV + Option Premium