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# Real Options: Overview and Applications

A Presentation in the  
“New Developments in Finance” Series

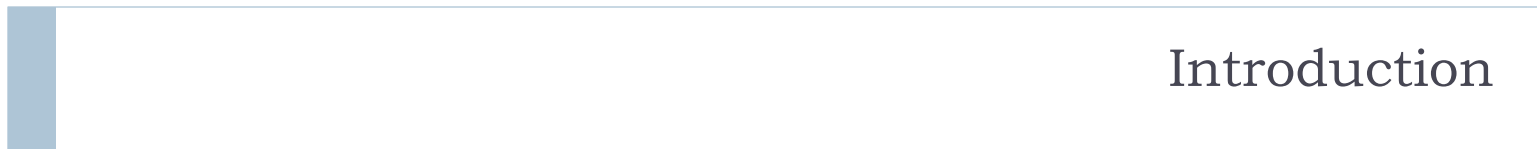
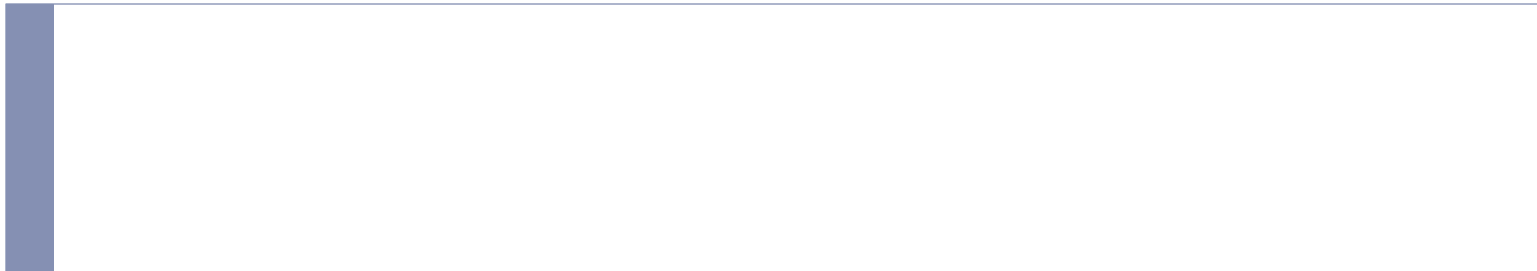
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# Part One



# What's It All About?

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The Goals of Real Options Analysis are to:

- ▶ Identify Flexibility in Investments, Projects, and Firms
- ▶ Value Flexibility
- ▶ Integrate Flexibility into Strategic Decision Making
- ▶ Manage Risk Inherent in Flexibility
- ▶ Increase Returns on Capital

Bottom Line:

- ▶ Real Options Analysis Gives Strategic Intuition  
Analytical Rigor and Discipline



# Background: What is an Option?

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- ▶ **Financial Contract**
  - ▶ Right (not Obligation) to buy or sell
- ▶ **Common in Financial Markets**
- ▶ **They Can be Priced and Evaluated**
- ▶ **Mathematical Models Have Been Developed (1973)**
  - ▶ Variables affecting value are identified
- ▶ **A Real Option is an Option on a Real Asset**
  - ▶ Same methodology can be used for pricing options on real assets



# Pricing and Evaluation

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- ▶ Five Variables of Option Pricing
    - ▶ Exercise Price (Cost of Investment)
    - ▶ Time (How Long to Exercise?)
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- ▶ Interest rate
  - ▶ Asset Value (Market Value)
  - ▶ Risk or Volatility or Variability



# An Example

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- ▶ Stock Trades at \$50
- ▶ You Want Option to Buy Stock at \$50
- ▶ You Can Exercise at the End of One Year
- ▶ Interest Rate is 3.5%
- ▶ Stock Price Varies by 20% Over the Year
- ▶ What's The Option Worth?

\$ 4.82



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Options are Everywhere

The Trick is to Learn to Spot Them

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# Some Alternatives Are Easy to Spot...

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- ▶ Option to Buy a Building
- ▶ Option to Expand or Contract Leased Space
- ▶ Option to Terminate
- ▶ Option to Renew





# ...Others Are More Difficult

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- ▶ Options in Developing an Office Park
  - ▶ Embedded Options Add Flexibility
    - ▶ Build office as planned
    - ▶ Add a hotel or retail space
    - ▶ Develop a park
    - ▶ Sell
    - ▶ Hold and wait
  - ▶ Values May Change Over Time
  - ▶ No Option Has Negative Value



# Real Options: A New Way to Think

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- ▶ Spotting Options
  - ▶ New perspective required
- ▶ Valuing Options
  - ▶ Methodology exists
- ▶ Enhancing Options
  - ▶ Strategic work
- ▶ Exploiting Options
  - ▶ The when and how of strategy
  - ▶ Flexibility = Opportunity



# Who Uses Real Options?

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- ▶ British Petroleum
- ▶ Enron
- ▶ Hewlett-Packard
- ▶ Chevron
- ▶ Airbus Industrie
- ▶ Stern Stewart & Co.
- ▶ Amazon.com
- ▶ Legg-Mason
- ▶ Asea Brown Boveri (ABB)
- ▶ Agouron Pharmaceuticals
- ▶ PowerGen
- ▶ Apple Computers
- ▶ Anadarko Petroleum
- ▶ Merck



## Part Two

DCF vs. Real Options

# Financial Analysis

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- ▶ Based on the Concept of Net Present Value (NPV)
- ▶ Discount Cash Flows and Subtract Investment
- ▶ Resulting in a Single Value (NPV)
- ▶ Decision Rule
  - ▶  $NPV > 0$ , Accept Project
  - ▶  $NPV < 0$ , Reject Project



# NPV is Limited

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- ▶ Time is the Only Dimension
  - ▶ Cash flows are forecast and discounted
- ▶ No variability to expected cash flows
- ▶ Ignores Flexibility in Decision Making
  - ▶ External Variables
  - ▶ Internal Variables
- ▶ Go or No Go decision is Made Immediately



# Real Options are Multi-Dimensional

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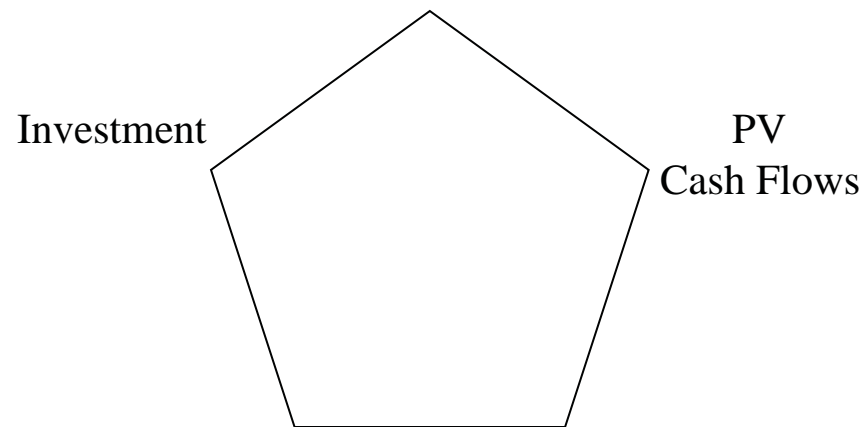
- ▶ Time is Not the Only Variable
  - ▶ Value of flexibility can be determined
- ▶ Probabilities are Included



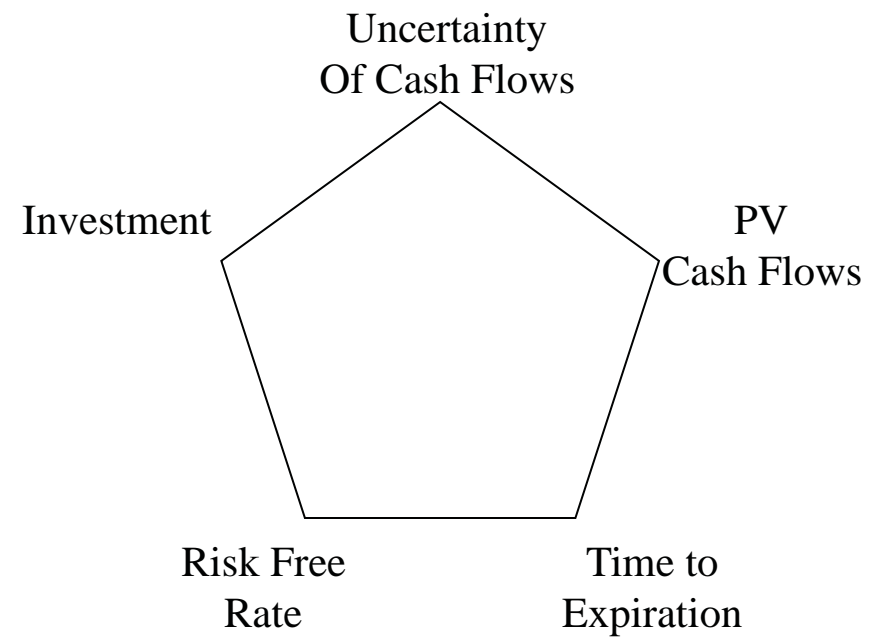
# NPV vs. Real Options

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## NPV



## Real Options





# Part Three

Using Real Options

# Why Use Real Options Analysis?

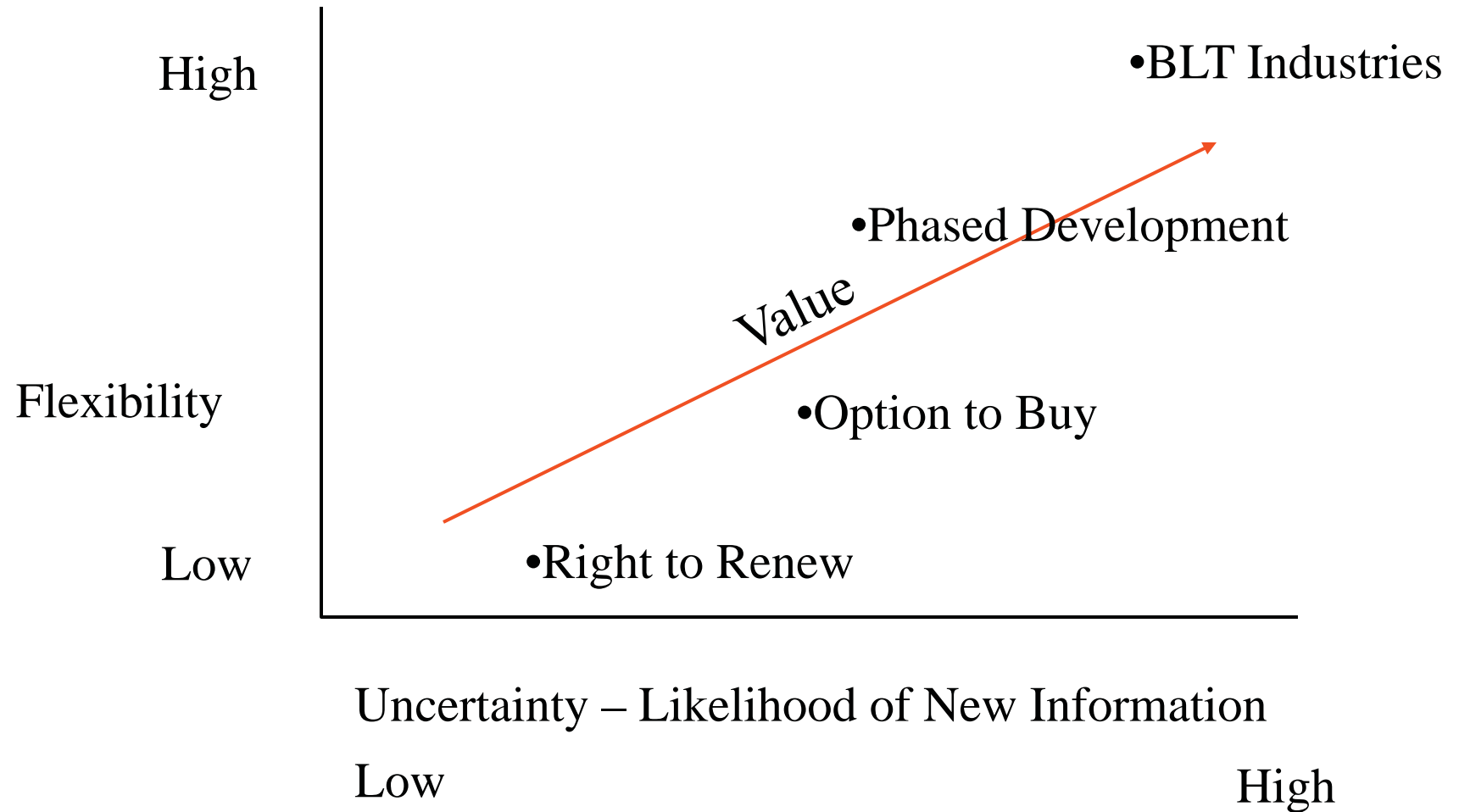
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- ▶ To Spot, Value, Enhance, and Exploit Flexibility
- ▶ Flexibility Has Value
- ▶ Flexibility Key to Adapting to Change
- ▶ Flexibility Key to Competitiveness



# Value of Managerial Flexibility

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# Flexibility Value is Greatest When:

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- ▶ **High Uncertainty About Future**
  - ▶ Likely to receive new information over time
- ▶ **Management has Room to Maneuver**
  - ▶ Can respond to new information
- ▶ **Project is Close to Hurdle Rate**
  - ▶ Decision can go either way
  - ▶ Management can preserve flexibility



# How to Use Real Options Analysis

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- ▶ **To Strengthen and Guide Overall Strategy**
  - ▶ Identify Options Embedded in Projects and Investments
- ▶ **To Guide Real Estate Decision-Making**
  - ▶ From Raw Land Acquisition to Final Construction
  - ▶ Build or Not to Build Decisions
  - ▶ Technological Enhancement
  - ▶ Lease Evaluation
- ▶ **To Value Alternative Investments**
  - ▶ Venture Capital, Direct Investments
- ▶ **To Value Acquisitions**



# By Managing Real Options Proactively Management Can Affect Value

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- ▶ Increase Value of Option
  - ▶ Extend Option Duration
    - ▶ Maintain regulatory barriers
    - ▶ Signal ability to exercise
    - ▶ Innovate to hold competitive lead
  - ▶ Increase PV of Cash Flow
    - ▶ Develop marketing strategies
    - ▶ Develop alliances and JVs
  - ▶ Reduce Present Value of Fixed Costs
- Monitor Impact of Changes in Risk Free Rate
  - Manage Risk
    - Extend opportunity
    - Product innovation
    - Product bundling
  - Reduce Value Lost Waiting to Exercise
    - Create barriers to entry
    - Lock up resources



# Part Four

Real Options as Strategy

# A Real Estate Development Project

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Real Estate Development Project							
	in millions						
Pro-Forma Projections	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Rent		7.0	7.2	7.4	15.2	15.6	16.1
- Operating Expenses		1.7	1.8	1.8	3.8	3.9	4.0
- G&A		0.3	0.4	0.4	0.8	0.8	0.8
Net Operating Income		4.9	5.0	5.2	10.6	11.0	11.3
Cash Flows							
- Investment	47.0			53.0			
- CapEx		0.7	0.7	1.0	1.0	1.0	1.0
Free Cash Flow	-47.0	4.2	4.4	-48.8	9.6	10.0	10.3
Terminal Value							102.8
Discount Rates							
10% Discount	1	0.909	0.826	0.751	0.683	0.621	0.564
PV	-47.0	3.8	3.6	-36.7	6.6	6.2	63.8
NPV of Project	0.3						





# Rearrange the Proformas

Real Estate Development Project (Rearranged)							
Phase One							
	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Free Cash Flow	0.0	4.2	4.4	4.6	4.7	4.9	5.1
+ Terminal Value							51.3
- Investment	-47.0						
10% Discount	1	0.909	0.826	0.751	0.683	0.621	0.564
PV	-47.0	3.8	3.6	3.4	3.2	3.1	31.8
<b>Phase One NPV =</b>	<b>2.0</b>						
Phase Two (Expansion Option)							
	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Free Cash Flow				-0.40	4.9	5.0	5.2
+ Terminal Value							51.5
- Investment				-53.0			
10% Discount				0.751	0.683	0.621	0.564
PV				-40.1	3.3	3.1	32.0
<b>Phase Two NPV =</b>	<b>-1.7</b>						
In Sum							
	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Free Cash Flow	0.0	4.2	4.4	4.2	9.6	10.0	10.3
+ Terminal Value							102.8
- Investment	-47.0	0.0	0.0	-53.0	0.0	0.0	0.0
10% Discount	1	0.909	0.826	0.751	0.683	0.621	0.564
PV	-47.0	3.8	3.6	-36.7	6.6	6.2	63.8
<b>Summary NPV =</b>	<b>0.3</b>						



# Focus on the Embedded Option

Phase Two (Expansion Option)								
		<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
	Free Cash Flow				-0.4	4.9	5.0	5.2
	+ Terminal Value							51.5
	- Investment				-53.0			
	10% Discount				0.751	0.683	0.621	0.564
	6% Discount				0.840			
	PV at 10%				-40.1	3.3	3.1	32.0
	PV at 6%				-44.8			
	Phase Two NPV =		-6.4			PV Years 4 through 6		38.4
	New Summary NPV =		-4.4					



# Valuation of the Option

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Investment	B-S Variable	B-S Component
PV of Free Cash Flow	$S$	Underlying Price
Costs of Capital Project	$X$	Exercise Price
Time to Decision	$t$	Time to Expiration
Time Value of Money	$R_f$	Risk-free rate of return
Riskiness of Project	$\sigma$	Standard Deviation



# Identifying $S$ , $X$ , $t$ , $R_f$ , $\sigma$

$S$  = Value of the Underlying = 38.4

$X$  = Exercise Price = 53

$t$  = Time to Expiration = 3

$R_f$  = Risk-free Rate of Return = 6%

$\sigma$  = Riskiness of Project = 30% (assumed)

Black-Scholes Calculation							
	S	\$ 38.40					
	X	\$ 53.00					
	log R	5.83%					
	t	3.00					
	$\sigma$	30.0%					
	delta	0.00%					
	d1	-0.0237					
	d2	-0.5434					
	N(d1)	0.490531					
	N(d2)	0.293443	= probability that underlying will finish in the money				

# A Portfolio of Real Options...

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- ▶ **Any Number of Projects Can be Analyzed**
  - ▶ In terms of value
  - ▶ In terms of risk
  - ▶ In terms of timing
- ▶ **They Can Then be Assembled into a Strategy**



...Can be Arranged to Form a Strategy  
Based on Value, Risk, and Timing

