

# BSM939

# Risk and Uncertainty in Business

Lecture 1  
Risk and Uncertainty

Sumon Bhaumik  
<http://www.sumonbhaumik.net>

***Basics***

# Risk vs. uncertainty

- “To an economist, risk is defined as the existence of uncertainty about future outcomes”

Source: Kimball (2000)

- Are they the same?
  - **Risk** implies that the likelihood (or probability) of something happening is measurable
  - **Uncertainty** implies that there is no precise estimate of the likelihood of occurrence of an event

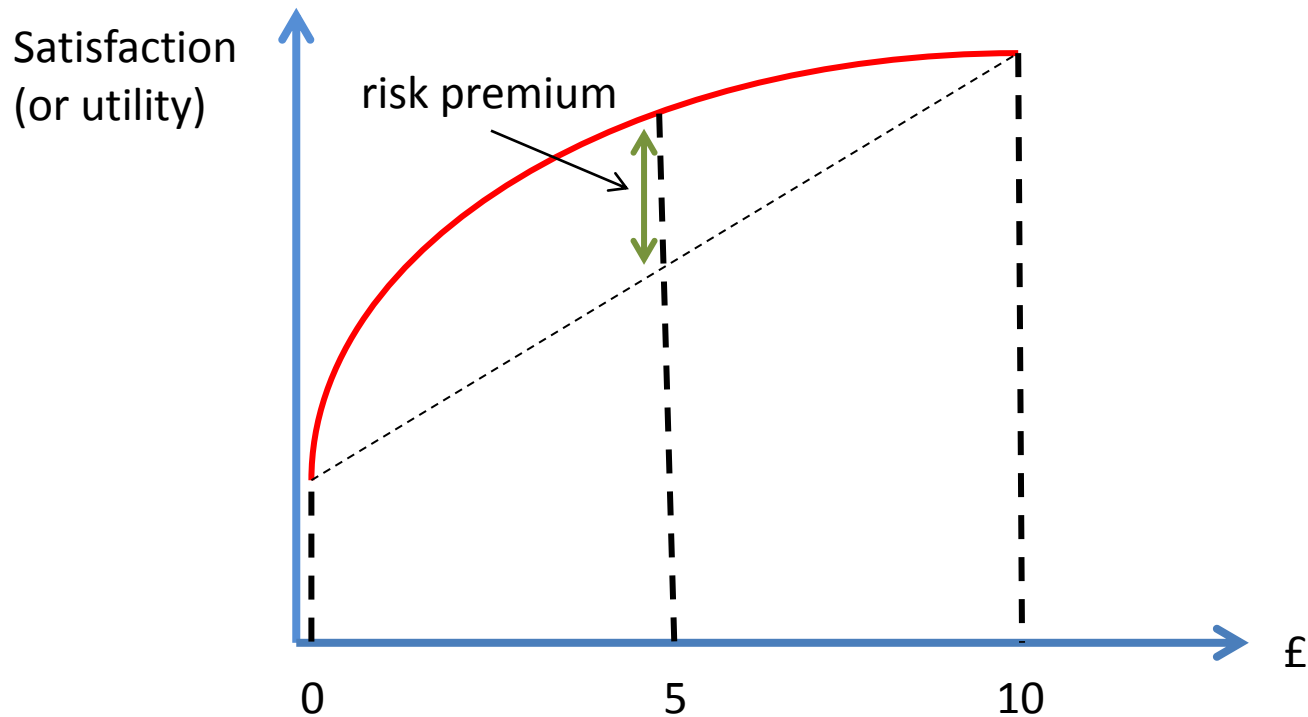
Source: Knight, F.H. (1921). *Risk, Uncertainty and Profit*, Boston, MA: Hart, Schaffner & Marx; Houghton Mifflin Co. The book is in public domain and accessible at

<http://www.econlib.org/library/Knight/knRUP.html>.

- Implication
  - In principle, it is possible to manage risk, but it is difficult to manage uncertainty

# The human beings behind strategic decisions

## Mainstream theory of risk aversion



- Implication
  - People prefer certainty over uncertainty
  - If people are required to take risk, they would have to be compensated with a suitable risk premium

# The human beings behind strategic decisions

## Prospect theory

- People think about outcomes of their choices in terms of profits and losses, i.e., in terms of deviations from some reference point
- People treat gains and losses differently
  - They are risk averse with respect to profits (i.e., opt for a certain outcome) but accept the risk and are willing to gamble if they know that a loss is very likely
  - They have *loss aversion*, i.e., the negative impact of a loss is greater than the positive impact of a profit or gain (an implication of which is the *endowment effect*)
- People are far more likely to adopt strategies that would change the likelihood of an outcome at the extremes (when probability is close to either 0 or 1) than in the middle range
- People making a choice between two alternatives focus on the differences rather than on the similarities

# ***Behaviour under uncertainty***

# Strategic decisions under uncertainty

## Real options

Category	Description	Important in
Option to defer	Management holds a lease on (or option to buy) valuable land. It can wait ( $x$ years) to see if output prices justify constructing a plant or developing a field.	All natural resource extraction industries; real estate development, farming, etc.
Time to build option (staged investment)	Staging investment as a series of outlays creates the option to abandon enterprise in midstream, if new information is unfavourable. Each stage can be viewed as an option on the value of subsequent stages.	All R&D intensive industries, especially pharmaceuticals; long development capital-intensive projects; start-up ventures.
Option to abandon	If market conditions decline severely, management can abandon current operations and realise resale value of the assets in second-hand markets.	Capital intensive industries, such as airlines and railroads, financial services, new product introductions in uncertain markets.

# Primer on option theory

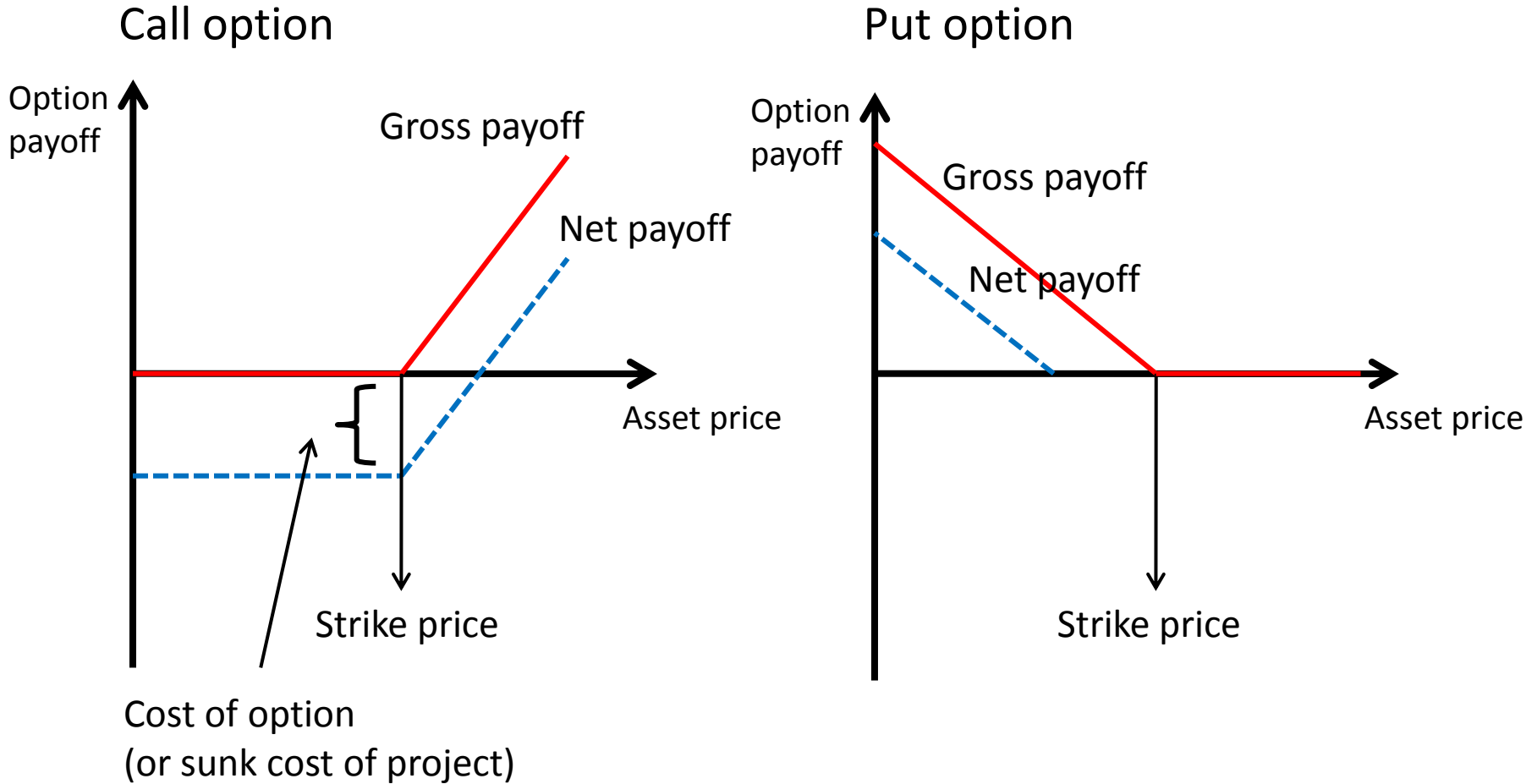
## Call and put option

- Option
  - The *right* (but not the obligation) to buy or sell an asset at a predetermined price
  - Call: Right to *buy* the asset at a predetermined price
  - Put: Right to *sell* the asset at a predetermined price
- Strike price
  - The predetermined price at which the asset can be bought or sold
- Strike date
  - The date of exercise of the option
  - European: The option has to be exercised *on* the exercise date
  - American: The option has to be exercised *on or before* the exercise date



# Primer on option theory

## Payoff structure



# Primer on option theory

## Determinants of option value

- Uncertainty (or project risk)
  - Option value increases with the degree of uncertainty; the greater the uncertainty, the better is the ability to wait and yet retain the right to an action such as investment in a project
- The time to expiration
  - Option value increases with time to expiration
- The interest (or discount) rate
  - Option value decreases if there is an increase in the interest or discount rate, as future cash flows from exercising the option are discounted heavily
- Exclusivity
  - Option value is higher if the benefits from exercising the option accrues exclusively to the option's owner; it is lower if the benefits have to be shared with others

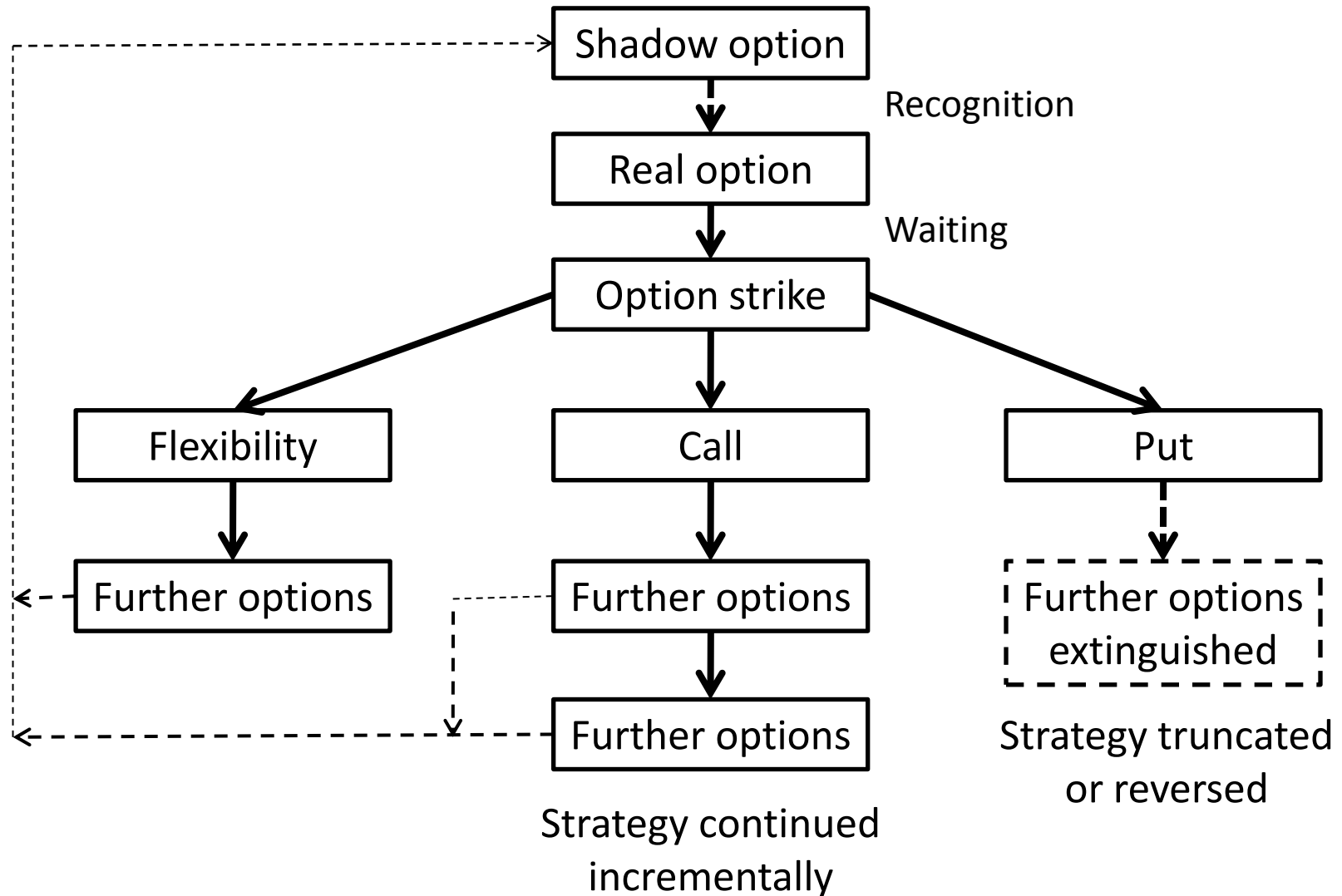
# Real options

## Strategy as an option chain – basics

- Strategies are produced by sequentially entering into, exercising, abandoning or selling options
- Options can be *incremental* options or *flexibility* options
  - Incremental options are simple *calls* or *puts*
  - Call options that define strategies can be reversed or sold (e.g., selling a JV share to the JV partner)
  - Flexibility options facilitate strategic change (e.g., producing oil and gas while investing in green technology)
- The process starts with a firm's management recognising the potential to gain in the future by gaining access to an asset or developing a technology (shadow option) and then making a small investment to secure preferential access to the asset or taking a step towards development of the capability

# Real options

## Strategy as an option chain – visualisation



# Real options

## Strategic dimensions

- Who benefits from the exercise of the option?
  - Shared vs. proprietary
- Is there a direct benefit from holding the option, or does it pave the way for other opportunities in the future?
  - Simple vs. compound
- How urgently will I have to decide on whether to exercise the option?
  - Expiring vs. deferrable

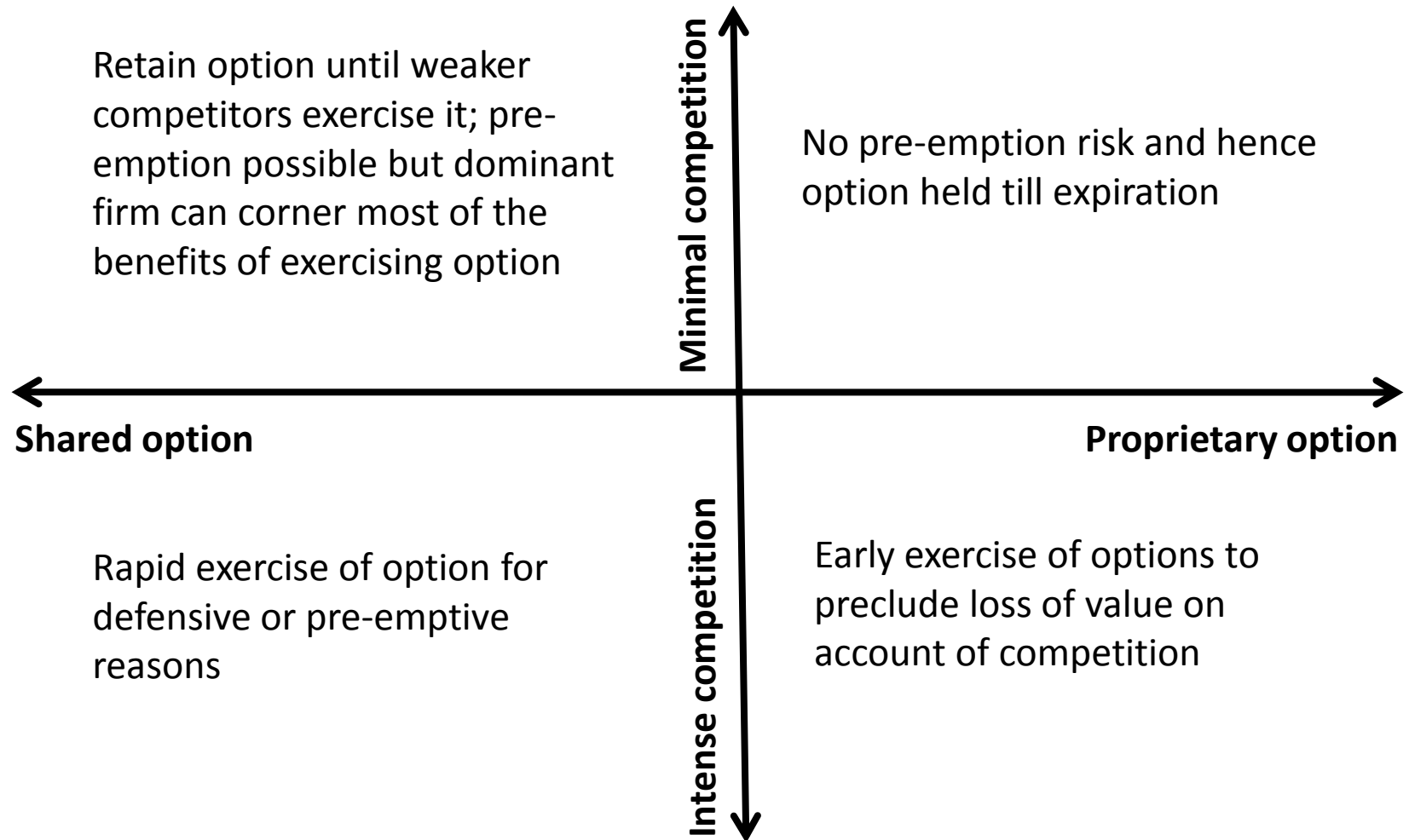
# Real options

## Strategic dimensions – examples

Proprietary	Simple	Expiring	Routine maintenance
		Deferrable	Plant modernisation
	Compound	Expiring	Immediate franchise offer
		Deferrable	R&D of a unique product
Shared	Simple	Expiring	Bidding for purchase of a firm's assets
		Deferrable	New product introduction (with close substitutes)
	Compound	Expiring	Bidding for acquisition of an unrelated company
		Deferrable	Opportunity to enter a new geographic market

# Real options

## Strategic dimensions: application – I



# Real options

## Strategic dimensions: application – II

- When would a firm enter a market?
- Neoclassical economics
  - As soon as the profitability of incumbent firms in an industry increases, the marginal benefit of entering the market will increase for the potential firm, exceeding its cost of capital; the firm should therefore enter
  - If there is no entry, it is on account of strategy adopted by the incumbent firm(s) to keep out potential competitors
- Real options approach
  - Given any level of profitability of incumbent firms, there is value in waiting for further information about demand etc before making an irreversible investment
  - Hence the profitability of the incumbent firms will have to be much higher than the cost of capital before the potential entrant exercises the option to enter and thereby exhausts the option value of waiting



# Real options

## Impact of organisational forms

- Firm divided into divisions, each of which produces an output (M-form)
  - The corporate office manages the options associated with all the divisions
  - If each division represents an option, the corporate office in effect manages a portfolio of options
  - The management of these options is done by way of acquisitions (of new options) and divestitures (or sale of options)
- Keiretsu
  - Functionally independent firms, generally from the same business group, organised around a main bank
  - The firms have functional independence, and hence each manages (i.e., buys, exercises and sells) its own options
  - Offers a more effective way to manage options than the M-form structure

# ***Managing risk***

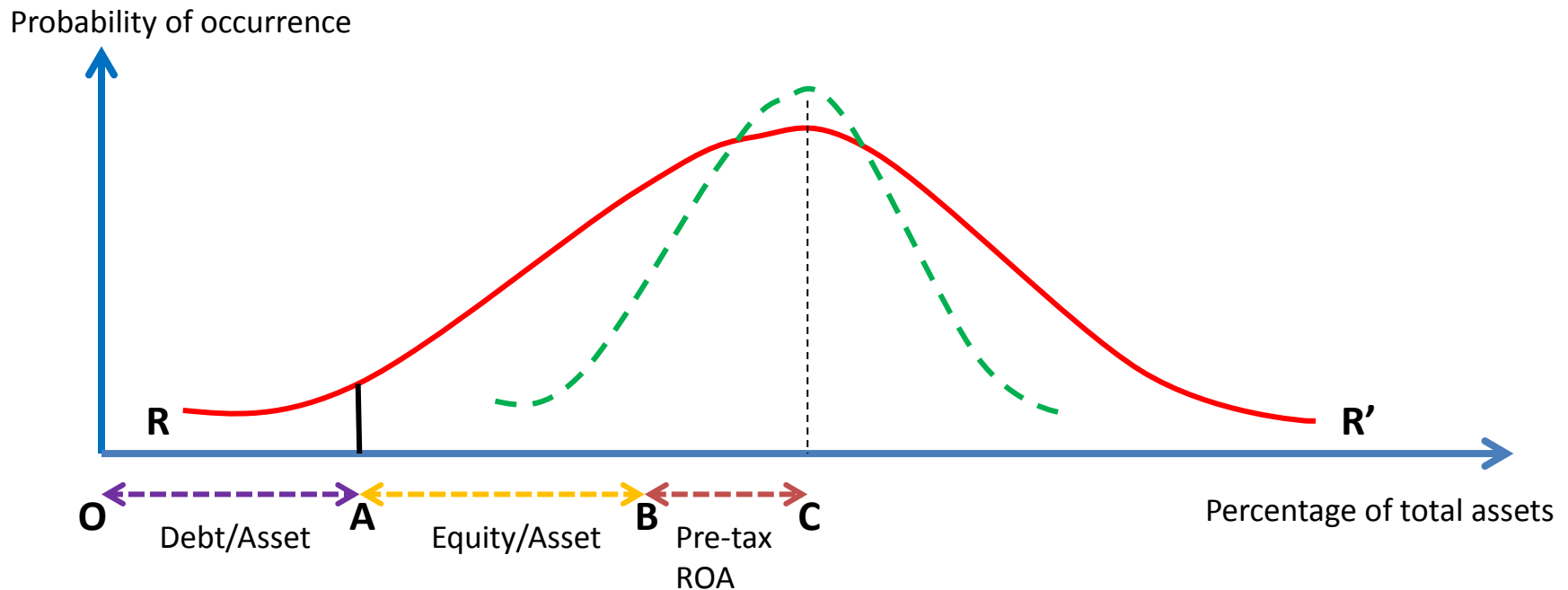
# Managing risk

## Fundamentals

- Objective
  - “The challenge confronting today’s CFO is thus to maximise firm value by choosing the mixture of securities and risk management products and solutions that gives the company access to capital at the lowest possible weighted cost.”  
Source: Culp (2002)
- Risk management enhances firm value by ensuring that the firm continues to make (prudent) strategic investments that involve taking risk
  - Reduces the expected costs of a sudden reduction in cash flows or earnings
    - A fair proportion of a firm’s investment can be internally financed
    - In the event of distress the focus shifts to reorganisation and survival, and increases conflict between debt holders and share holders, all of which can deter the best use of available investment opportunities
  - Reduces the risk aversion of managers

# Managing risk

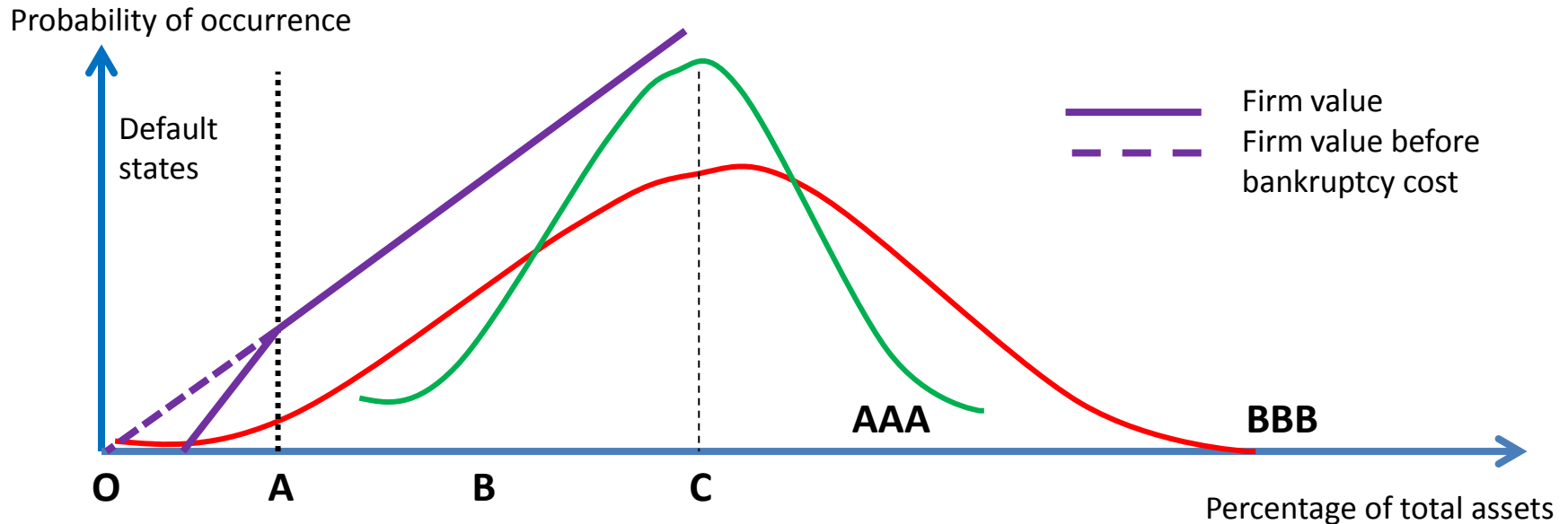
## Decision about capital structure – I



- $RR'$  is the distribution of pre-tax ROA around its average
- If the loss is larger than the equity capital, then there will be insolvency
- The firm has to choose the capital structure that will minimise the likelihood of insolvency
- **How does risk management help?**

# Managing risk

## Decision about capital structure – II



- Should Firm AAA undertake risk management?
- Should a firm undertake risk management if it is in distress?
- Should closely held firms be more active with risk management?
- Would firms in which managers own stock options manage hedge against risks?

Source: Stulz, R.M. (1996). Rethinking risk management, *Journal of Applied Corporate Finance*, 9(3). pp. 8-24; Figures 1 & 2 (adapted).

# Managing risk

## Advances

- Consistent measurement of risk
  - Market risk (value-at risk, cash flow-at-risk)
  - Credit risk (e.g., expected default rate)
  - Operational risk
  - Capital-at-risk: “**CaR** is a measure of the capital necessary to support *all* risks that are associated with that business line’s expected economic profit”

Source: Culp (2002)
- Gradual realisation that the focus should be on the exposure to risk than on the products that are used to manage risks
- Evolution of *equitized* risk management products that do not just pay after specific risk events, but will protect the value of a company against *all* risks

# Managing risk

## Problems

- Problems with measurement
  - What if the distribution of the relevant variable is not normally distributed?
    - Distributions skewed to the left imply that bad outcomes are more likely than good outcomes
    - “Fat tailed” distributions imply higher probability of extreme risks
  - What if risks are correlated over time?
    - In the presence of such correlation, a firm can experience bad outcomes in successive periods of time
  - What if different types of risks are correlated?
    - If risks associated with different products, locations etc are correlated then overall risk cannot be reduced through diversification
- Problems with *ignorance* (or hubris)
- What if there is a risk that a firm cannot mitigate at a reasonable cost?

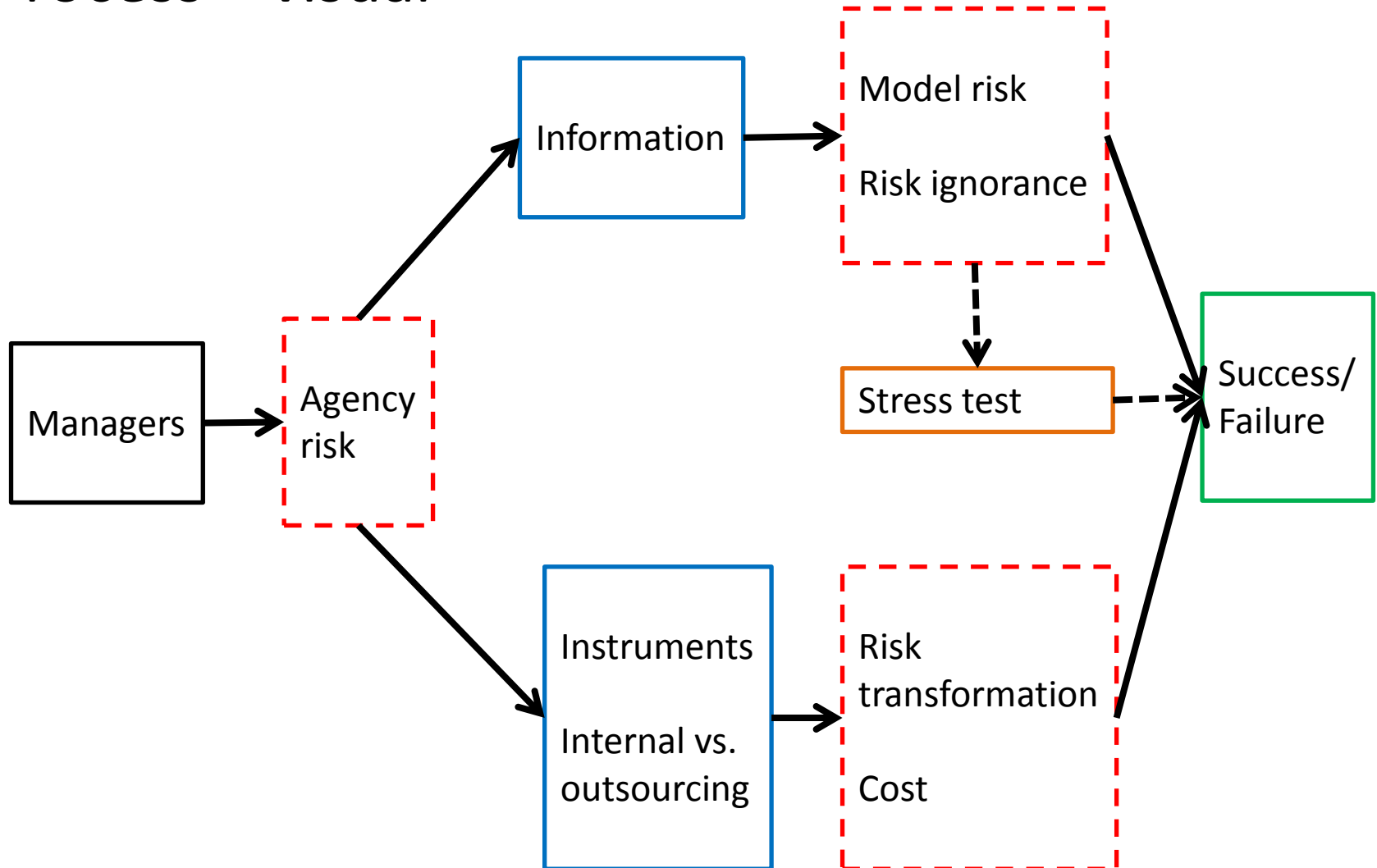
# Risk management

## Process – stages

- Identification of all material “natural” risk exposures
- Risk retention decision by the firm’s managers and directors
- Measurement of the firm’s actual risk exposures for comparison with risk tolerance
- Monitoring and reporting deviations between actual risk exposure and risk tolerance
- Actions, processes and systems required to manage deviations between actual risk exposure and risk tolerance
- Oversight, audit, tuning and re-alignment of risk management as a continuous process



# Risk management Process – visual



# Risk management Mismanagement

- Reliance on historical data
- Focus on narrow measures of risk
- Overlooking *knowable* risk
  - Risks outside normal risk class
  - Risks associated with hedging
  - Risks associated with market concentration
  - Risks associated with assumption of values when markets are illiquid
- Overlooking *concealed* risk
- Failure to communicate
- Failure to manage risk in real time

# Risk management Framework – visual

Mandate and commitment

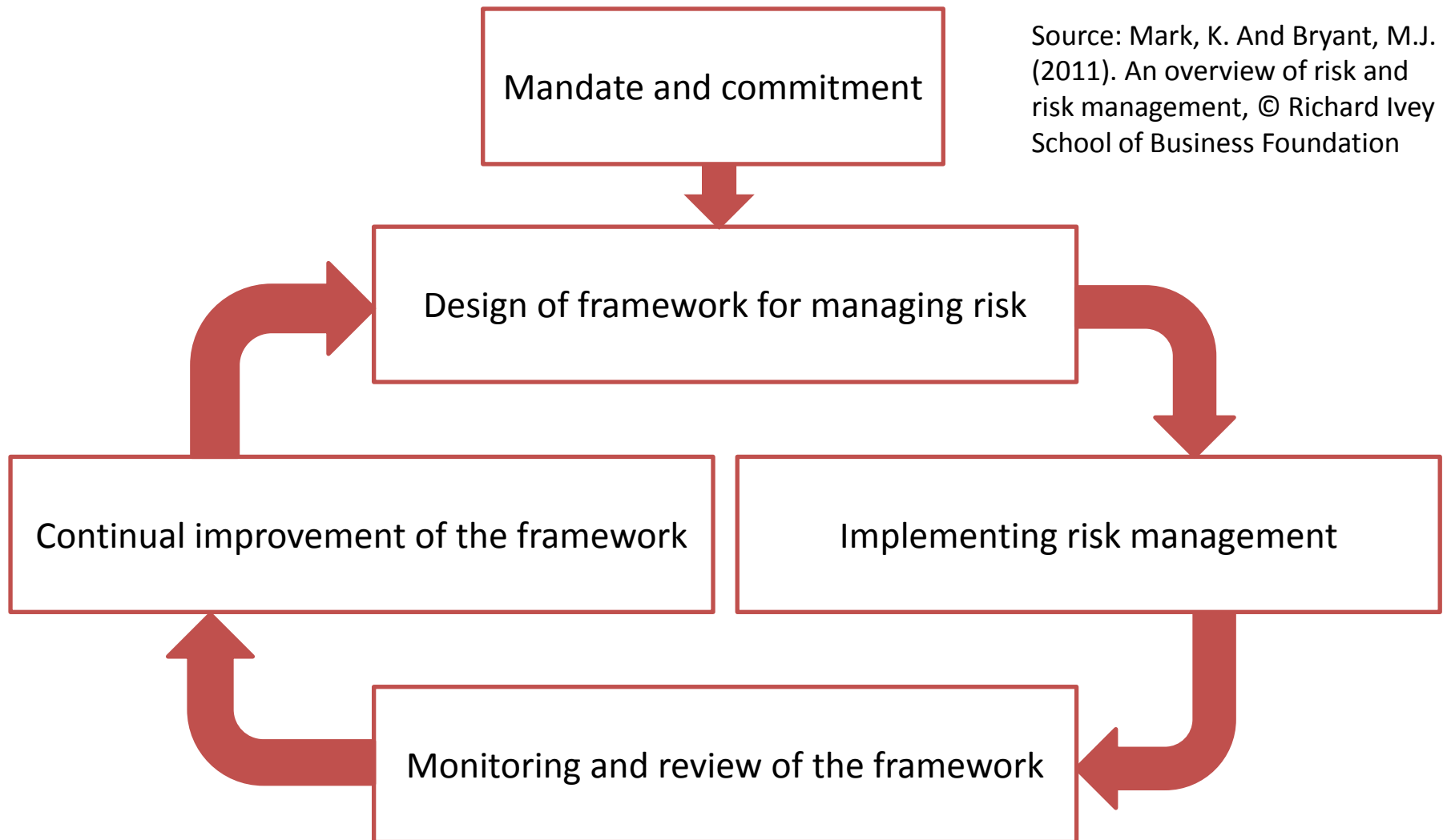
Source: Mark, K. And Bryant, M.J.  
(2011). An overview of risk and  
risk management, © Richard Ivey  
School of Business Foundation

Design of framework for managing risk

Continual improvement of the framework

Implementing risk management

Monitoring and review of the framework



***Where do we go from here?***

# Looking ahead

- Understand sources of risk
- Understand how they can be managed or hedged
- Use case studies to understand why specific risk management strategies may (or may not) be successful