

## **Analysis of Investment Projects**

Level: Graduate Program in Economics and Finance

### **Aims**

This course is designed to bridge the gap between theory and practice concerning investment decisions. The course review current techniques of capital budgeting and details an approach based on the pricing of (real) options that provides a means of quantifying the elements of managerial flexibility in the face of unexpected changes in the markets. Also the course discusses the strategic value of new technology, the interdependence of projects, and competitive interactions both for private and public investments.

### **Topics included**

#### Part A: Introduction

- 1) Capital Budgetin
- 2) The Contingent Claim Analysis (CCA)
- 3) Real Options
- 4) Simple Examples
  - Managerial flexibility
  - Forest resources
  - Weather derivatives
  - Scale production → Call option
  - Land use → Put option

#### Part B: Tools

- 5) Continuous stochastic processes and Ito's Lemma
- 6) Stochastic Dynamic Programming (SDP)
- 7) Valuation of the Option to Wait to Invest
- 8) Optimal investment rule using CCA
- 9) Optimal investment rule using SDP
- 10) Black and Scholes - Merton formula
- 11) The Beta for Options
- 12) Interactions among Multiple Real Options
  - Moothballing - Option to Shut Dow and Restart
  - Optimal Scrapping - Operating Option
  - Abandonment value - Option to Exit
  - Set Aside - Option to Switch

#### Part C: Investment Theory Under Uncertainty

- 13) Value of a Firm as a sum of Operation Options
  - Sequential Investment – Compound Options
  - Two Stage Projects
  - The Central Planner Decision
  - A Competitive Industry

#### 14) Strategic Investment, Real Options and Games

- The Preemption game
- War of Attrition game
- The Value of Learning
- Sequential Games: A Supply Chain Example
- Principal Agent in Continuous Time
- Procurement Auctions

#### Part D: Case Studies

##### 15) Possible Applications

- Land use (2 h)
- Concession length and investment timing flexibility (2 h)
- Optimal timing problems in environmental economics (2 h)
- Water concession length (2 h)
- Valuation of small hydropower plants (2h)
- Valuation of a PV plant (2h)
- Input price risk and optimal timing of energy investment: choice between fossil and biofuels (2h)
- Public Policies and Incentives to Accelerate Irreversible "Green" Investments (2h)

#### References

- Myers S. (1984), Finance Theory and Financial Strategy, Interfaces vol.14, pp.126-127.
- Dixit A.K. and Pindyck R.S., (1994), Investment under Uncertainty, Princeton University Press: Princeton NJ.
- Trigeorgis L. (ed.) (1995), Real Options in Capital Investments: Models, Strategies and Applications, Westport Conn.: Praeger.
- Trigeorgis L. (1996), Real Options, Managerial Flexibility and Strategy in Resource Allocation, MIT Press: Boston MA.
- Micalizzi A. e Trigeorgis L. (eds.) (1999), Real Options Applications, EGEA- Edizioni Giuridiche Economiche Aziendali Dell'Università Bocconi e Giuffrè editori: Milano I
- <http://www.realoptions.org>

#### Teaching methods

Lectures (examples of investment case studies will be analysed during the lectures).

#### Intended learning outcomes

Knowledge and valuation of how firms and public authorities should evaluate investment opportunities

**Examination**

Written Exam and/or Projects

**Required Prerequisites**

Microeconomics and Mathematics of Financial Markets.

Mathematics of Financial Derivatives,

Elements of Stochastic Dynamic Optimization