Chapter 17: Real Options - Lecture Notes

Focus on Section 17.3: Real Options in Practice

Lecture Notes

2026-01-20

Big Picture: What This Chapter Is Really About

Up to this point, options lived in financial markets: stocks, bonds, futures. Chapter 17 makes a conceptual pivot: **Real assets behave like options once managers have discretion.**

Factories, power plants, and oil fields are not passive cash-flow streams; they are **decision machines**. Decisions create *nonlinear payoffs*, which is exactly what option theory was invented to price.

> **Key Principle:** You cannot value a real asset without simultaneously modeling how it will be operated.

Section 17.3 is where this theory collides with reality.

From NPV to Real Options

Traditional Net Present Value (NPV) assumes: - You invest now or never. - You operate continuously. - You cannot adapt once conditions change.

Real options relax these assumptions: - **Waiting** is a call option. - **Shutdown** is a put option. - **Restart** is another call option. - **Staging** is a compound option. - **Operational flexibility** is an exotic option.

Section 17.3 — Real Options in Practice

The authors identify four broad classes of real options: 1. **Timing options** – when to invest. 2. **Operating options** – shut down, restart, abandon. 3. **Growth (strategic) options** – investing to create future options. 4. **Flexibility options** – choosing inputs, outputs, or technologies.

We focus on the canonical application: **Peak-load electricity generation**.

Peak-Load Electricity Generation

This is *the* real-options model for energy markets.

The Physical Reality

Electricity prices are highly volatile, spike during scarcity, mean-revert strongly, and can even be negative. A peak-load plant produces only when profitable and exists precisely to exploit price spikes. It is not a standard asset; it is a **portfolio of options**.

The Option Structure

Each hour, the plant faces a decision:

$$\text{Profit} = \max(S_{elec} - H \cdot S_{gas}, 0)$$

Where: - S_{elec} = electricity price - S_{gas} = natural gas price - H = heat rate (conversion efficiency)

This payoff is identical to a **call option on electricity** with a **strike price tied to gas**, known as the **spark spread**. Owning a peak-load plant is equivalent to owning a strip of short-dated call options on the spark spread.

Static NPV vs Real-Options Value

- **Static NPV:** Assumes continuous operation. Often yields negative NPV.
- **Real-Options Logic:** Operate only when profitable. The value comes from **what you don't do**.

  Insight: Peak-load plants are profitable because of shutdown flexibility, not high average prices. Electricity volatility is an equilibrium signal, not a "bug."

Strategic Implications

Managerial flexibility adds value through: 1. **Timing Options:** The right to wait for better market conditions. 2. **Abandonment Options:** The safety net of shutting down a losing operation. 3. **Growth Options:** Pilot projects that open doors to massive future markets. 4. **Flexibility Options:** The ability to switch fuels or outputs based on prices.

Summary and Future Directions

Real options are not a replacement for NPV; they are **NPV done correctly when decisions are endogenous**. Ignoring optionality leads to systematic undervaluation of real assets.

This sets up: - Commodity extraction as an American option. - Shutdown and restart hysteresis. - Trigger-price economics. - Policy implications for energy markets.