Insurance, Weather, and Energy Derivatives

Chapter 29

Weather Derivatives: Definitions

- Heating degree days (HDD): For each day this is max(0, 65 – A) where A is the average of the highest and lowest temperature in ºF.
- Cooling Degree Days (CDD): For each day this is max(0, A – 65)

Weather Derivatives: Products

- A typical product is a forward contract or an option on the cumulative CDD or HDD during a month
- Weather derivatives are often used by energy companies to hedge the volume of energy required for heating or cooling during a particular month

Energy Derivatives

Main energy sources:

- Oil
- Gas
- Electricity

Oil Derivatives

- Virtually all derivatives available on stocks and stock indices are also available in the OTC market with oil as the underlying asset
- Futures and futures options traded on the New York Mercantile Exchange (NYMEX) and the International Petroleum Exchange (IPE) are also popular

Natural Gas Derivatives

- A typical OTC contract is for the delivery of a specified amount of natural gas at a roughly uniform rate to specified location during a month.
- NYMEX and IPE trade contracts that require delivery of 10,000 million British thermal units of natural gas to a specified location

Electricity Derivatives

- Electricity is an unusual commodity in that it cannot be stored
- The U.S is divided into about 140 control areas and a market for electricity is created by trading between control areas.

Electricity Derivatives continued

- A typical contract allows one side to receive a specified number of megawatt hours for a specified price at a specified location during a particular month
- Types of contracts:
  5x8, 5x16, 7x24, daily or monthly exercise, swing options

How an Energy Producer Hedges Risks

- Estimate a relationship of the form
  $$Y=a+bP+cT+\varepsilon$$
  where Y is the monthly profit, P is the average energy prices, T is temperature, and ε is an error term
- Take a position of $-b$ in energy forwards and $-c$ in weather forwards.

Insurance Derivatives

- CAT bonds are an alternative to traditional reinsurance
- This is a bond issued by a subsidiary of an insurance company that pays a higher-than-normal interest rate.
- If claims of a certain type are above a certain level the interest and possibly the principal on the bond are used to meet claims

Valuation Issues

- To a good approximation insurance, weather, and energy prices can be assumed to have zero systematic risk.
- This means that the "actuarial approach" and the risk-neutral valuation approach should give similar answers