# LECTURE 16: NATURAL RESOURCE ECONOMICS

14.42/14.420

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# Today's Class

- Natural Resource Economics

- <u>Agenda</u>
1. One Question: Are we running out of oil
2. Taxonomy of natural resources
3. Models of natural resource extraction
    1. Basically all one model, with variations on a theme.

# Are We Running Out of Oil?

- Before 1850s: Petroleum supplies limited to crude oil that reached the earth's surface

- 1855: Ad for Kier's Rock Oil: "Hurry, Before this wonderful product is depleted from nature's laboratory."

- 1859: Titusville, Pennsylvania: Col. Edwin Drake drills first successful oil well
  - Oil production in PA peaks in 1981
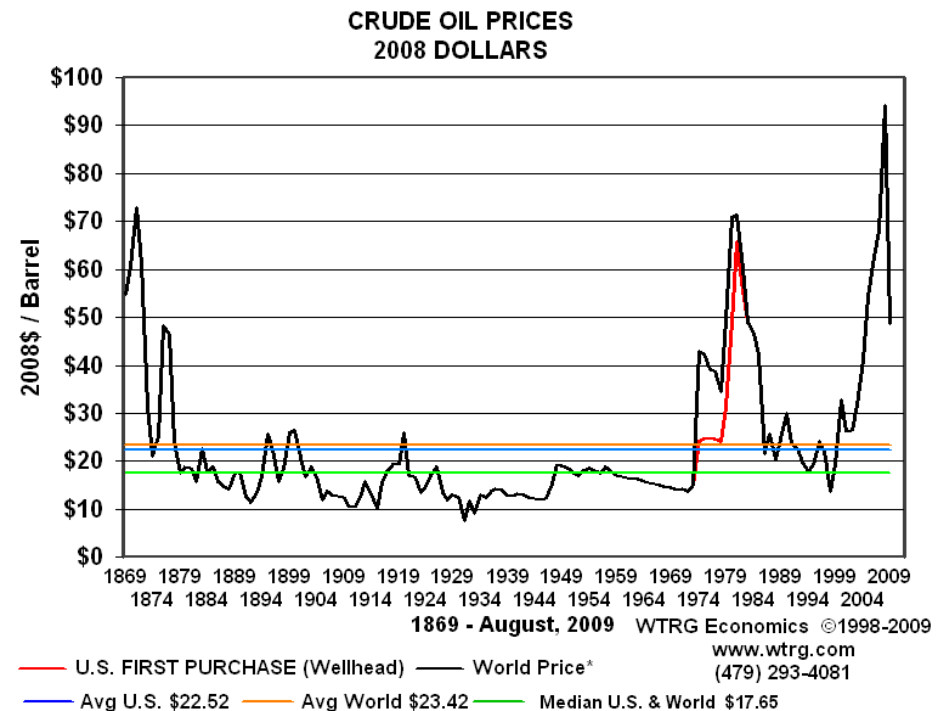
# Are We Running Out of Oil?

- 1874: Pennsylvania state geologist estimates that only enough oil in U.S. remained for the next four years.

- 1901: Spindletop oil gusher in Texas
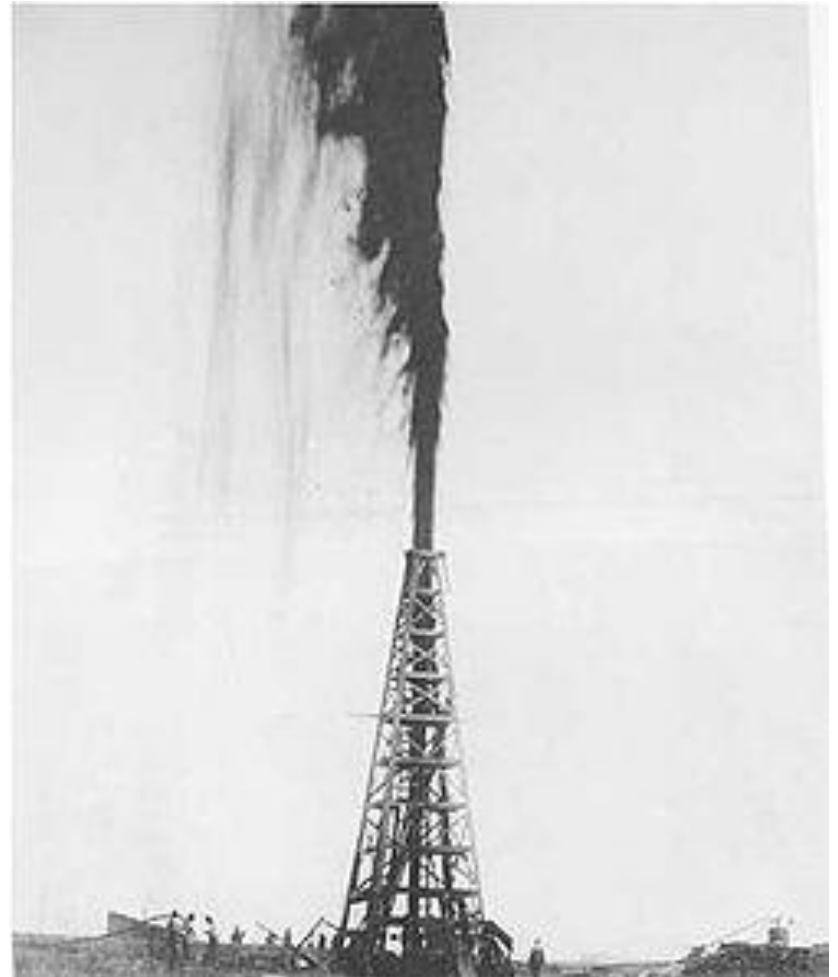
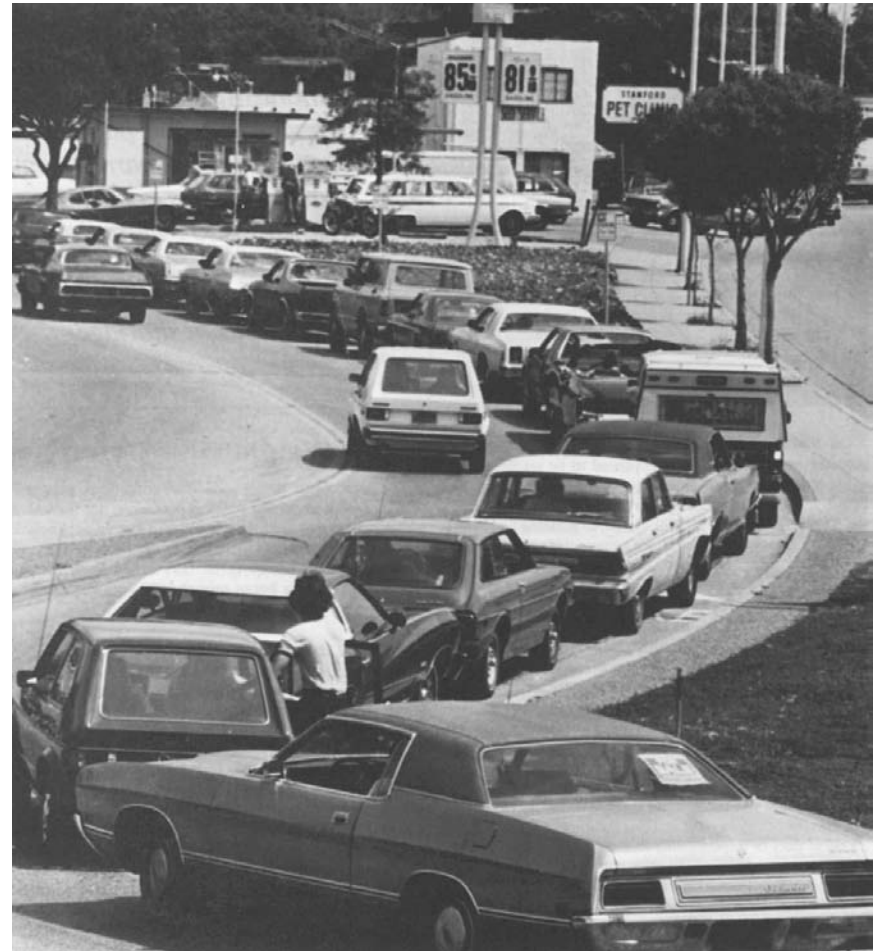

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# Are We Running Out of Oil?

- 1973: Arab Oil Embargo.
- 1973: Foreign Affairs Article: "The Oil Crisis: This Time the Wolf is Here."
- 1973: President Nixon: "We are running out of energy."
- 1977: President Carter predicts that the world will run out of energy in the 1980s.
- 1985: Oil prices drop precipitously and stay low for 15 years.

**CRUDE OIL PRICES
2008 DOLLARS**

2008$ / Barrel

1869 - August, 2009   WTRG Economics ©1998-2009
www.wtrg.com
(479) 293-4081

U.S. FIRST PURCHASE (Wellhead) —— World Price*
Avg U.S. $22.52 —— Avg World $23.42 —— Median U.S. & World $17.65

Courtesy of WTRG Economics. Used with permission.

# 1973 Gasoline Rationing

# Peak Oil

- 1956: M King Hubbert publishes peak oil model.
  - Logistic distribution of oil production
- Predicts US oil production would peak between 1965 and 1970.
  - US oil production peaks in 1970.
- Spawned many imitators/believers in peak oil.
- To be fair:
  - Also predicted global oil production would peak between 1993 and 2000
  - Predicted U.S. decline rate was too severe.





Annual U.S. Field Production of Crude Oil

Source: U.S. Energy Information Administration
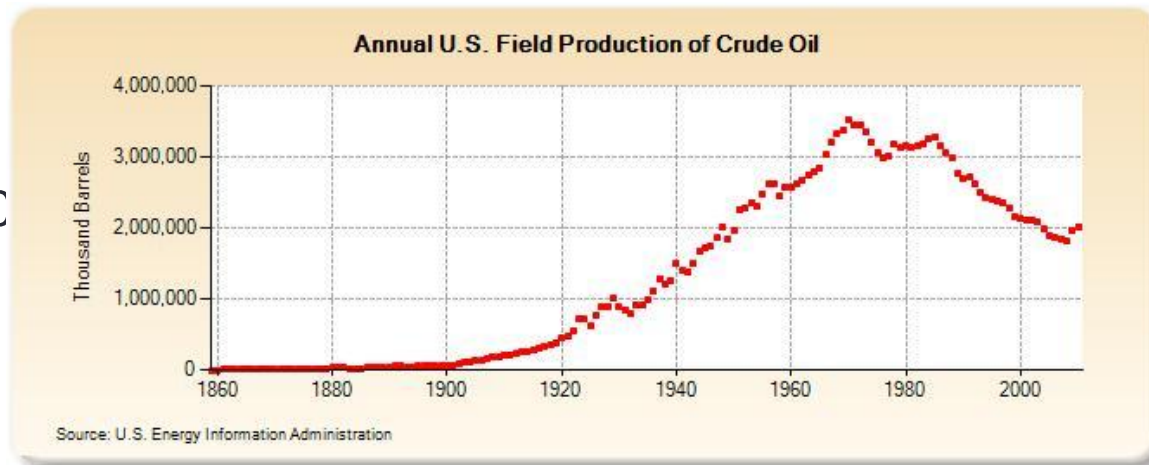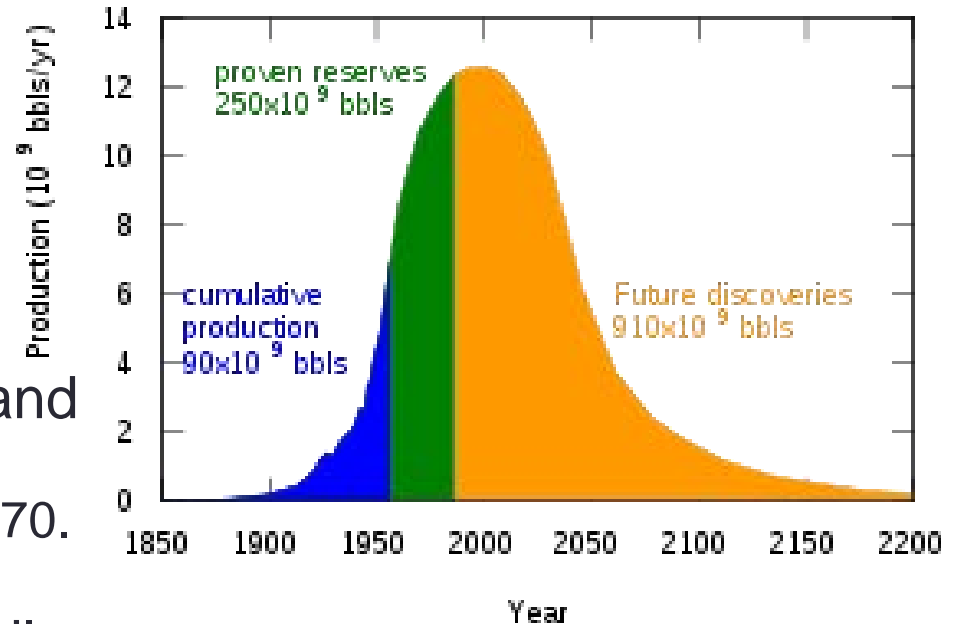
# A Few Questions

- Why does this matter?
  - The idea that we're "running out of oil" motivates very expensive alternative energy policies.
- What's wrong with Hubbert's model?
  - Oil production is just "quantity supplied." This is an equilibrium outcome! Depends on prices! Microfoundations:
    - Cost functions? Technological change?
    - Demand functions? Substitution?
  - There is a popular notion of resource "shortages." Remember that "shortages" almost never exist – except with government price caps.
    - Instead, need to think about equilibrium prices. Will they change slowly or abruptly?
- Ex-post, it's always possible to find prognosticators who were wrong. But . . .
- . . . is there another model that can help us understand the world more precisely?

# Natural Resource Economics Overview

- Natural resources are good provided by nature.
  - Oil
- Natural resource economics is about modeling the "optimal" utilization of these goods.

- <u>Economic questions</u>
- How much should we extract now vs. later?
- How do market extraction rates compare with the social optimum?
- What is the expected price pattern over time?
- How is the market sensitive to different changes?
  - Interest rates, expectations, market structures, cost structures, taxes

- <u>Popular questions:</u>
- Are we running out of oil?
- Is our current path "sustainable"?
- Should the government incentivize alternative energy technologies?

# Taxonomy of Resources

- Depletable/Exhaustible: Stock decreases with use and does not replenish. Model as fixed available quantity.
- Renewable: Stock recharges from period to period. Growth may depend on current stock.
- Expendable: Very fast adjustment period. Use of resource in one period does not affect subsequent periods.

- *Some people simplify this to "Renewable" and "Non-Renewable" resources*

- Also: Storable vs. Non-Storable Resources

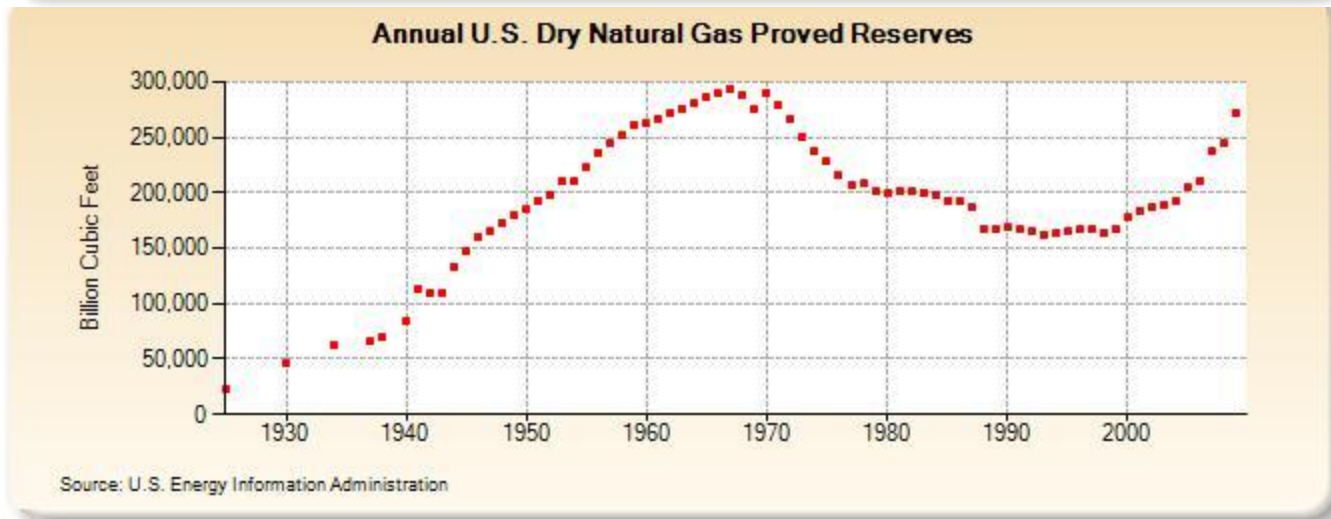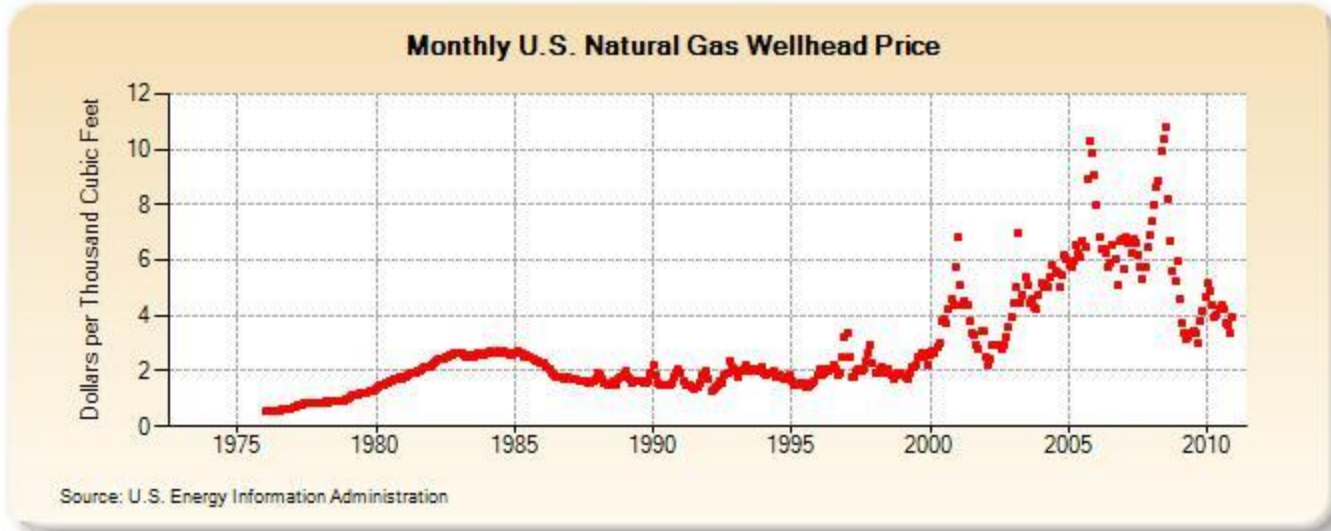- Today, we'll cover depletable resource models.

# Are We Running Out of Iron Ore?

- 1947: C.M. White, president of Republic Steel, calculates 5-7 years left of Mesabi range iron ore (Minnesota).
  - 60% of iron ore consumed during WWII came from the Mesabi range
- 1955: U.S. News and World Report reports no further worry over iron ore scarcity.
- Why? Pelletization.
  - Reduced extraction costs for inferior grades.

# Betting the Planet

- 1980: Ecologist Paul Erlich and economist Julian Simon bet about increased resource scarcity.

- Erlich picks 5 commodities of his choice: copper, chrome, nickel, tin, and tungsten.

- Essentially buys $200 of futures from Simon: if prices go up, Simon pays Erlich. If prices go down, Erlich pays Simon.

- 1990: Erlich sends Simon a check for $576.07
  - Real prices for each commodity was lower.

- How should prices change over time?

# Are We Running Out of Natural Gas in the United States?



Monthly U.S. Natural Gas Wellhead Price

Source: U.S. Energy Information Administration

Annual U.S. Dry Natural Gas Proved Reserves

Source: U.S. Energy Information Administration

# Recap: Non-Renewable Resources

- **Popular arguments:**
- We are running out of oil (and other resources)
- We will reach a point of shortages
- Or perhaps a sudden point of high prices

- **Models from Natural Resource Economics**
  - (Generally more sanguine)
- It is trivially true that we are running out of oil
  - But cost reductions and new discoveries have made past predictions premature
- Shortages only happen with price caps
- In theory, the market prices scarcity, prices rise at the interest rate.
- Without market failures, the market path is "dynamically efficient"
  - i.e. intertemporally Pareto Optimal
- Market failures: OPEC, imperfect information, property rights.
- Climate change is more likely to be the end of oil than scarcity.

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