Exhaustible resources II

Lecture 10

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Spring 2016

Three Topics

1. Hotelling does not match data
   - What should be changed to explain the data?
2. How to use the model in analysis
   - Comparative statics/dynamics
3. The issue of market power is important
   - Can we understand the oil market using this model?

Historical prices: not quite Hotelling path!

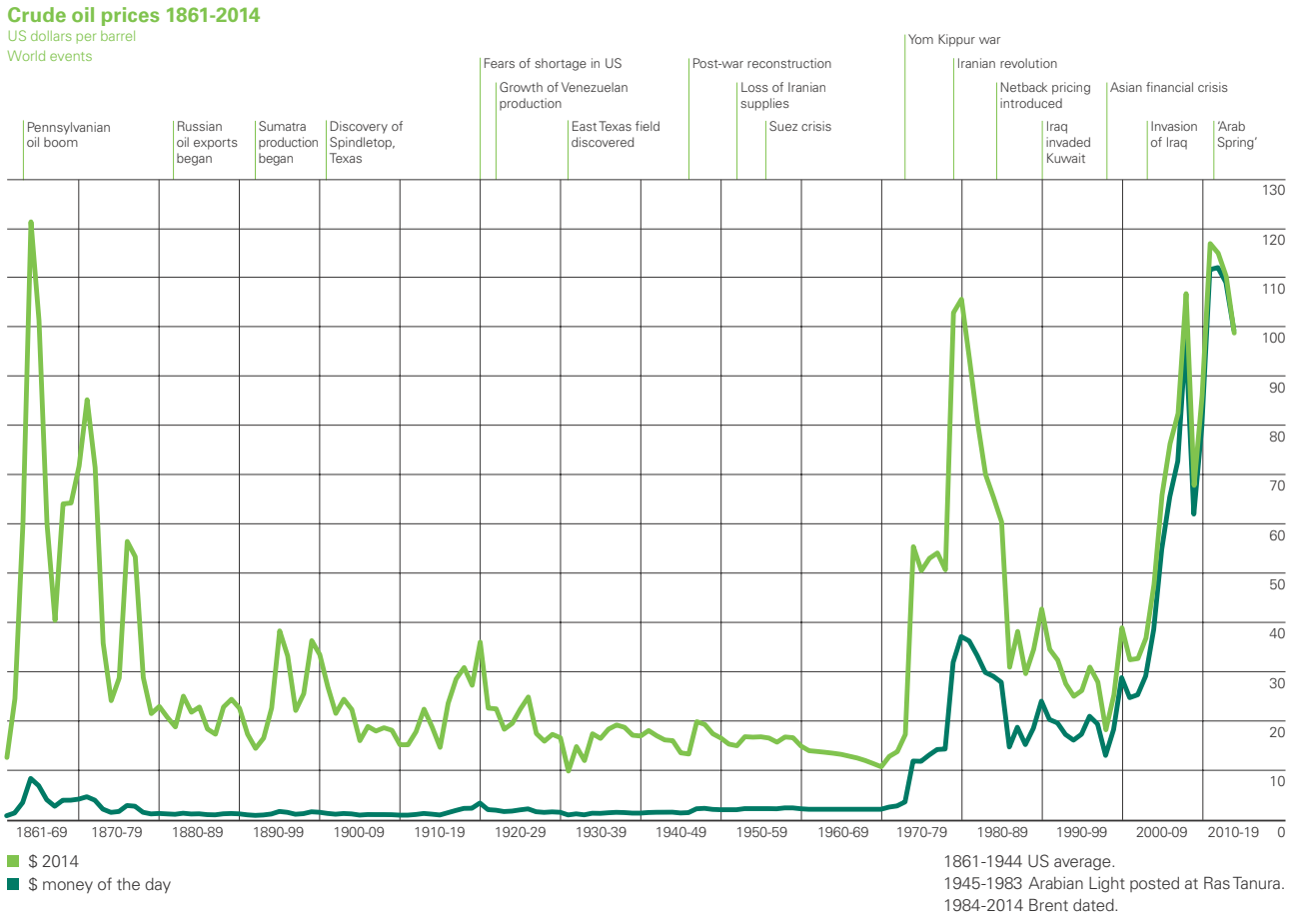
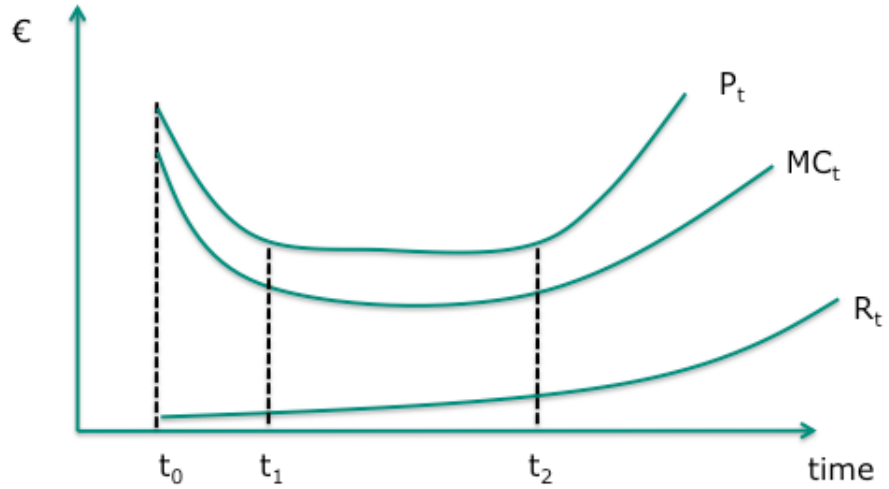


Figure: Source: BP statistical review of world energy 2015

Theory must be modified



- T0->t1: technological progress reducing extraction costs dominates
- T1->t2: technological progress and scarcity rents cancel out each other
- T2->: scarcity rent dominates. See Margaret Slade, J. of environmental economics and management (1982).

How to use the model in the analysis

To be analyzed in the class: what happens to the equilibrium path,

- if the interest rate becomes larger?
- if the substitute becomes cheaper?
- if there is unexpected increase in the resource stock?

The effect of the substitute: infinitely costly substitute

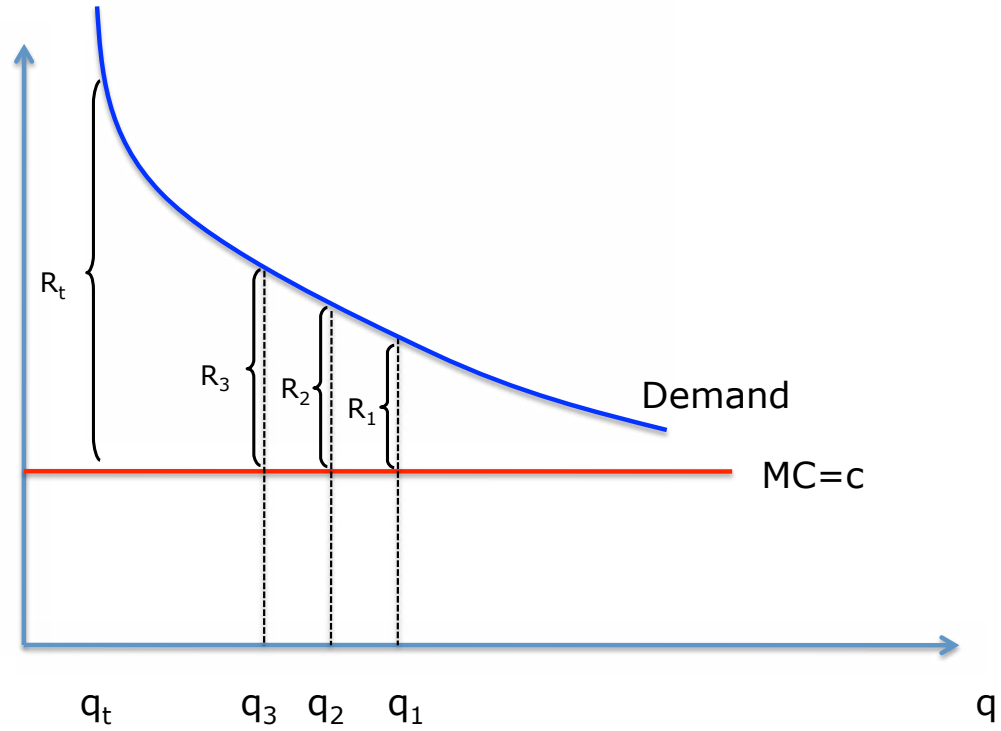


Figure: Consumption never stops: Price increases to make sure that we never suddenly run out of the stock; there is no finite choke price (resource is ”essential”)

The effect of the substitute: finitely costly substitute

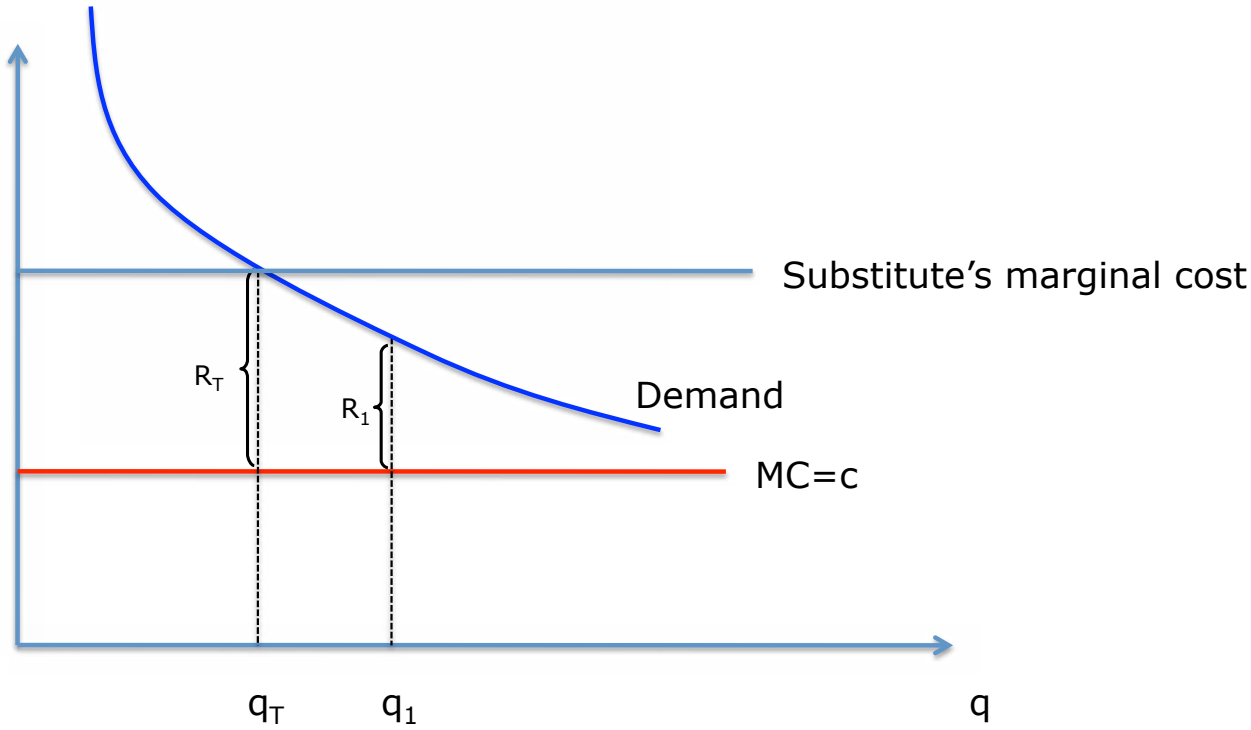


Figure: Substitute puts a limit on prices; the time period for resource consumption is finite

Exhaustible resources and market power

Ownership of some important resources stocks is concentrated. How would a larger producer exercise market power in an exhaustible resource market?

- Historical illustration: Chile was the monopoly producer of ”natural nitrogen” in 1880-1920.
- Sir William Crookes, the president of the British Association for the Advancement of Science, in 1889 appealed to chemists to develop a synthetic solution to the nitrogen problem, as otherwise ”All England and all civilized nations stand in deadly peril of not having enough to eat”, potentially as early as in 1930.
- What happened?

Historical illustration

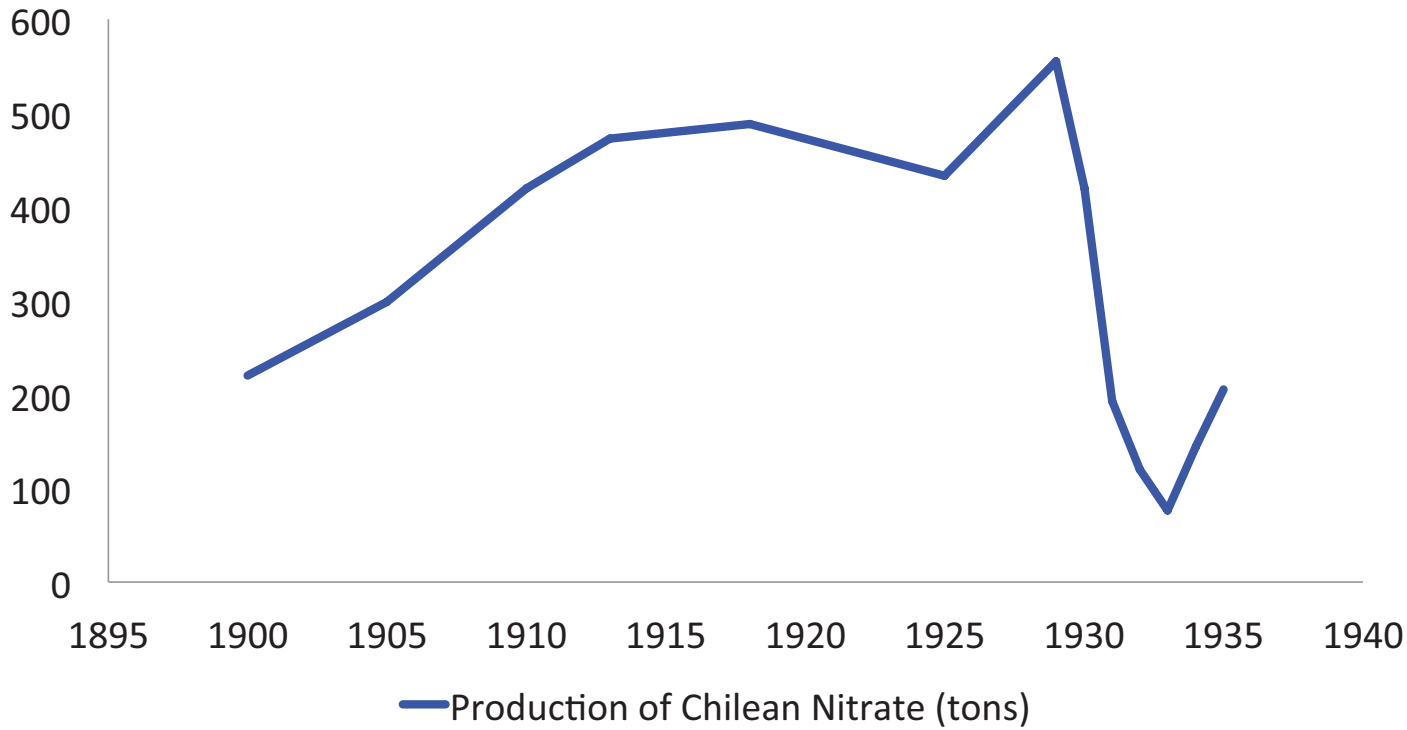


Figure: Chilean production over time

Haber-Bosch process for synthetic production

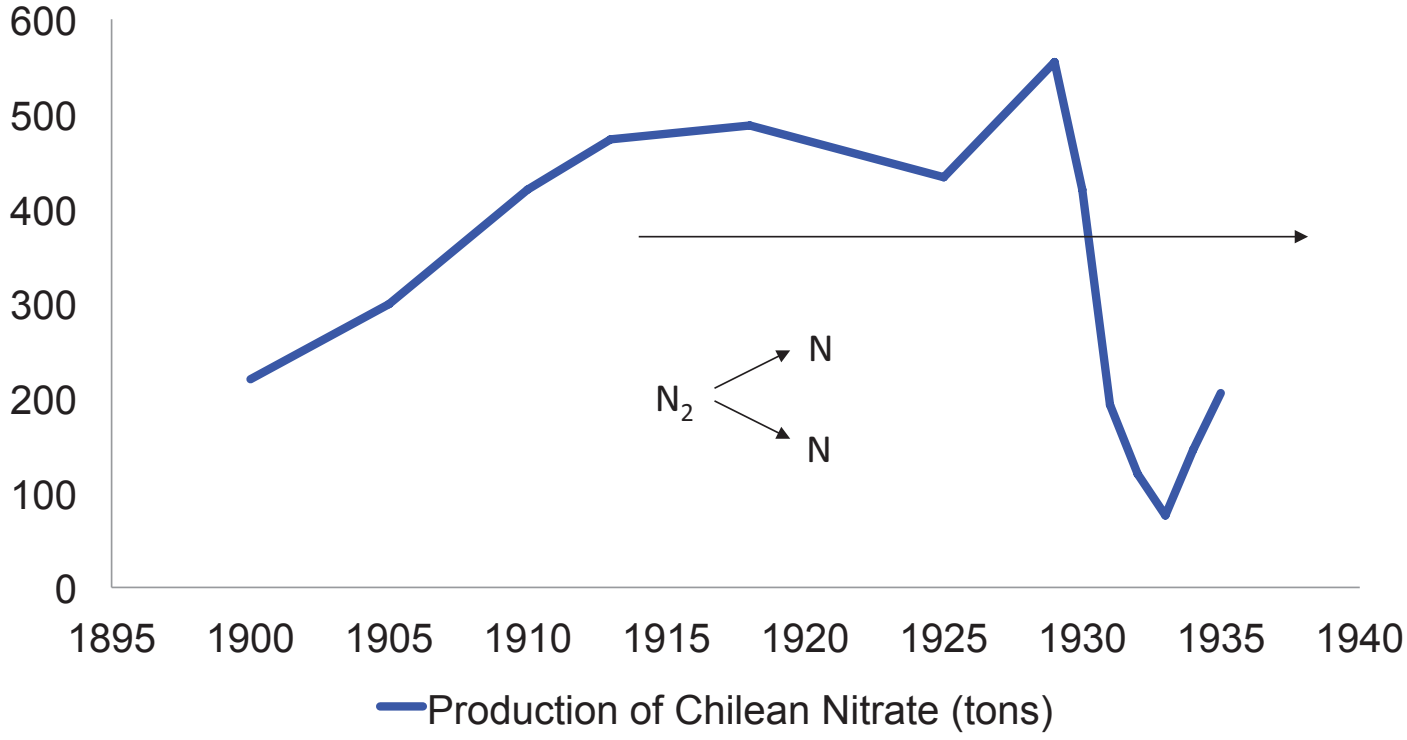


Figure: Chilean production over time

Monopoly resource owner

Back to theory: the monopoly is constrained by the substitute

- yet, the monopoly can still alter the timing of sales.
- as with reproducible goods, the monopoly follows familiar principle that ”marginal revenue=marginal cost”
- however, it is more difficult to identify marginal revenue and marginal costs than in the static case

Exhaustible resource monopoly

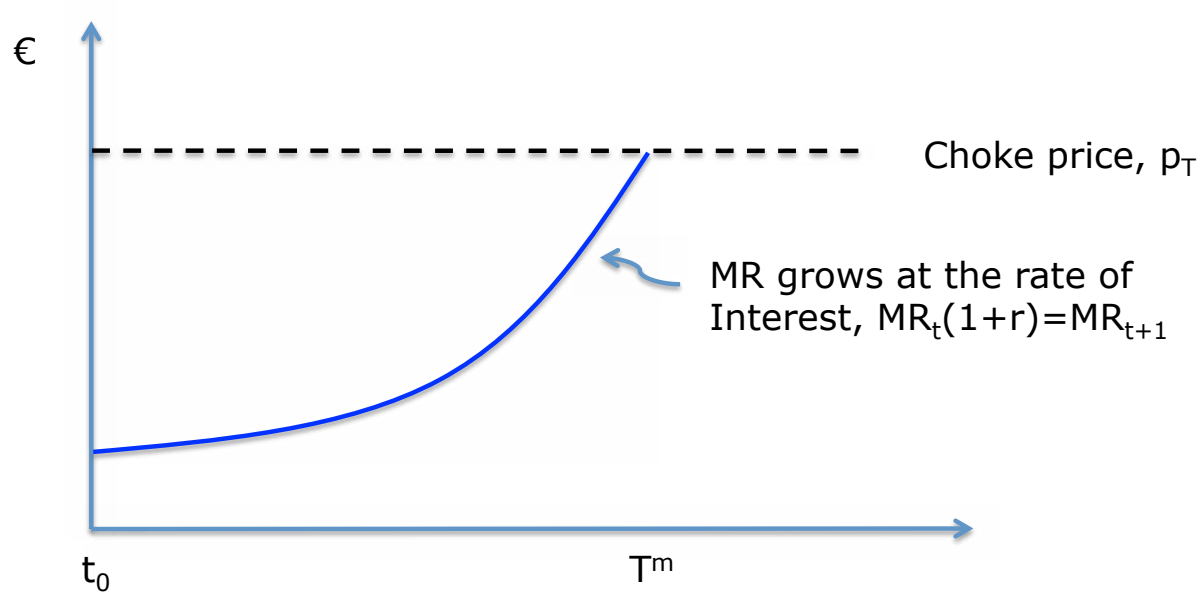


Figure: To be indifferent in which period to sell, the seller should receive the same MR from each period in present value

Exhaustible resource monopoly

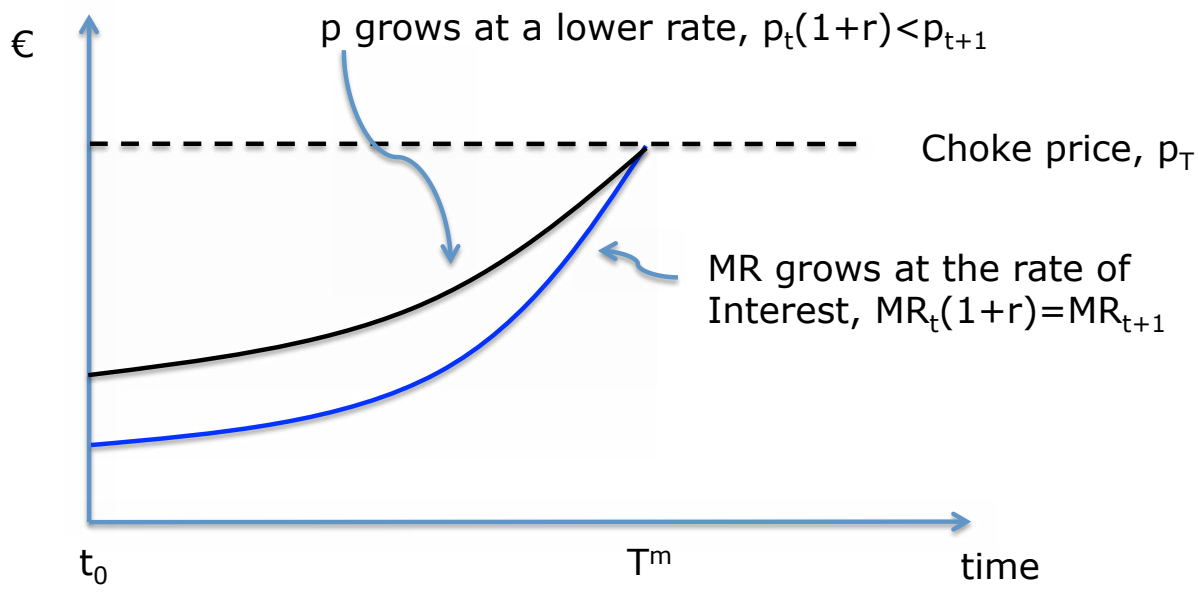


Figure: MR=p+(dp/dq)q=p(1+1/e), where e=elasticity of demand. Elasticity typically grows as supply declines, so p has to grow at a lower rate.

Exhaustible resource monopoly

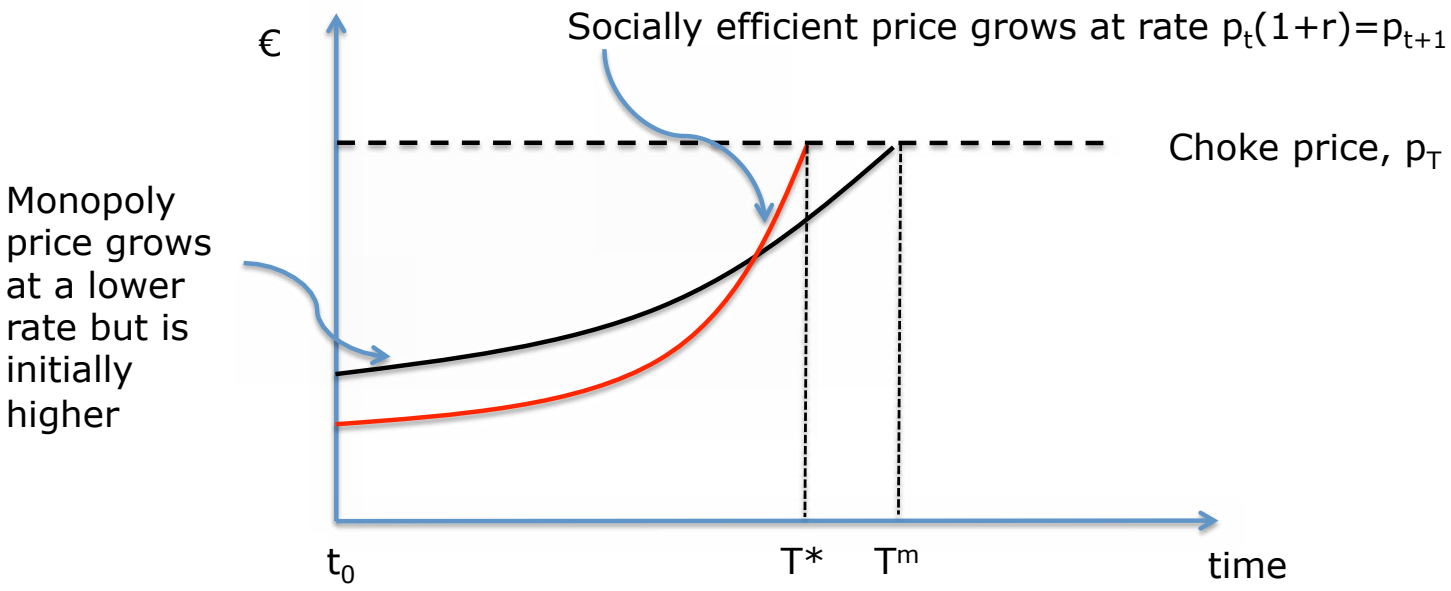


Figure: The monopoly is more conservative: it shifts supplies to the future to decrease current availability. Resource exhaustion time is delayed.