Rate of return regulation

Numerical Problem with Welfare Analysis

This problem walks you through a numerical example demonstrating different outcomes possible for a natural monopoly. Be sure that you've read the relevant section of Viscusi, Henderson and Vernon Chapter 12 for a theoretical treatment of this topic. This problem is based on problem 3 at the end of that chapter.

Problem Setup

MetroPower Co. is a regulated electric utility.

The (inverse) market demand curve for electricity is

$$P = 50 - 0.25Q,$$

where P is the price per MWh and Q is the number of MWh sold.

Cost structure:

If the firm operates efficiently, its technology allows it to produce electricity at a constant marginal cost of \$20 per MWh. At that efficient input mix, average cost is also \$20 per MWh.

However, under rate-of-return regulation, the utility is allowed to earn an above-market return on capital. This creates an Averch–Johnson (A–J) distortion: the firm uses too much capital and does not minimize cost. As a result, under regulation its average cost rises to \$22 per MWh.

We will compare **three outcomes**:

1. **Efficient competitive outcome (benchmark)**

   In a perfectly competitive, cost-minimizing industry:

   - Price equals marginal cost.
   - The firm uses the efficient input mix, so cost per unit is \$20.

   Call this the *competitive outcome*:

   $$P_C = 20.$$

   Using the demand curve, find the competitive quantity Q_C.

   Then compute:

   - Consumer surplus CS_C
   - Producer surplus PS_C (you can treat this as zero in long-run competitive equilibrium with constant cost)
   - Total surplus TS_C

2. **Unregulated monopoly**

   Now suppose MetroPower is an unregulated profit-maximizing monopolist. Assume it uses the *efficient* technology (so marginal cost is still \$20 per MWh).

   For a linear demand curve

   $$P = a - bQ,$$

marginal revenue is

$$MR = a - 2bQ.$$

For this market, that implies

$$MR = 50 - 0.5Q.$$

The monopoly chooses Q_M where $MR = MC$. Then it charges the price P_M from the demand curve.

Compute:

- Q_M, P_M
- Consumer surplus CS_M
- Producer surplus / profit PS_M
- Total surplus TS_M

Use cost \$20 per unit for profit.

3. **Rate-of-return regulation with Averch–Johnson distortion**

   Suppose the regulator sets an allowed price such that the firm charges

   $$P_R = 30$$

   and sells

   $$Q_R = 80.$$

   However, because the firm is rewarded for capital spending, it uses too much capital. Its average cost rises to \$22 per MWh instead of \$20. Assume this \$22 is also the effective marginal cost under regulation.

   Compute:

   - Consumer surplus CS_R
   - Producer surplus / profit PS_R
   - Total surplus TS_R

   Use $P_R = 30$, $Q_R = 80$, and per-unit cost \$22.

4. **Graph and interpretation**

   On one graph:

   - Put Q on the horizontal axis and P on the vertical axis.
   - Draw the downward-sloping market demand curve

     $$P = 50 - 0.25Q.$$

   - Draw a horizontal line at $P = 20$ to represent marginal cost when the firm is efficient.
   - (Optional but helpful) Draw a horizontal line at $P = 22$ to represent the higher, distorted cost under regulation with Averch–Johnson.

- Mark and label the three outcomes:

$$(Q_C, P_C) = (120, 20)$$

$$(Q_M, P_M) = (60, 35)$$

$$(Q_R, P_R) = (80, 30).$$

Then answer:

(a) Relative to the competitive benchmark, how does the monopoly distort the market?

(b) Relative to the competitive benchmark, how does the regulated firm with Averch–Johnson distortion distort the market?

(c) Which outcome (monopoly or regulation) creates the higher total surplus? Briefly explain why.