ECN 453: Pricing and Monopoly

Nicholas Vreugdenhil

Optimal pricing for a monopolist

- Today we will discuss **optimal pricing for a monopolist**.
- The 'optimal price' is the **price which maximizes profit**.
- Why is this useful?
  - Policymakers: understand how the monopolist is reducing welfare (due to its pricing)
  - Firm strategy: Suppose you are working as an economist in a firm that is launching a new product. How should you set prices for this new product to maximize profits?
- (Most of what we will see today is review from your previous courses)

Plan

1. Pricing: example using a table
2. Pricing: MR=MC
3. Pricing: elasticities
4. Welfare costs of monopoly pricing and regulation

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1. **Pricing: example using a table**
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Pricing: example using a table

- **Question:**

- You are working as an economist in a firm and you know demand and total cost in the table below for a new product.

- How should you set optimal prices (prices that maximize profit)? (In this example you can only sell whole numbers of the product.)

price	demand	TR	MR	TC	MC	profit
6	0			4.5		
5	1			5		
4	2			5.5		
3	3			6		
2	4			6.5		
1	5			7		

Pricing: example using a table

- **Question:**

- You are working as an economist in a firm and you know demand and total cost in the table below for a new product.

- How should you set optimal prices (prices that maximize profit)? (In this example you can only sell whole numbers of the product.)

price	demand	TR	MR	TC	MC	profit
6	0	0	-	4.5	-	-4.5
5	1	5	5	5	0.5	0
4	2	8	3	5.5	0.5	2.5
3	3	9	1	6	0.5	3
2	4	8	-1	6.5	0.5	1.5
1	5	5	-3	7	0.5	-2

- **Idea:** Keep raising prices so long as $MR \geq MC$.

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Pricing: MR=MC

- In the previous example we could only sell whole numbers of the product.
- When we can sell fractions of the product (which we usually assume) then the optimal price will occur when:

$$MR = MC$$

- This is a very important formula.
- I will now apply the formula to solve for a monopolist's optimal price.
- (This should be a review from your previous courses)

Pricing: MR=MC: monopoly example

- **Question:**

- Suppose a monopolist faces the demand curve $q = 2 - \frac{1}{5}p$ and has constant marginal cost of 5. What is the optimal price?

Pricing: MR=MC: monopoly example

- **Question:**
- Suppose a monopolist faces the demand curve $q = 2 - \frac{1}{5}p$ and has constant marginal cost of 5. What is the optimal price?
- **Solution:**
- Compute MR from the demand curve using the 'double the slope' rule: MR = 10-10q
- Next, use MR=MC to find the optimal quantity:

$$\underbrace{10 - 10q}_{MR} = \underbrace{5}_{MC}$$

- Rearranging, get the optimal quantity: $q^* = 0.5$.
- Finally, plug in $q^* = 0.5$ to the demand curve to get the optimal price:

$$p^* = 10 - 5 \times 0.5 = 7.5$$

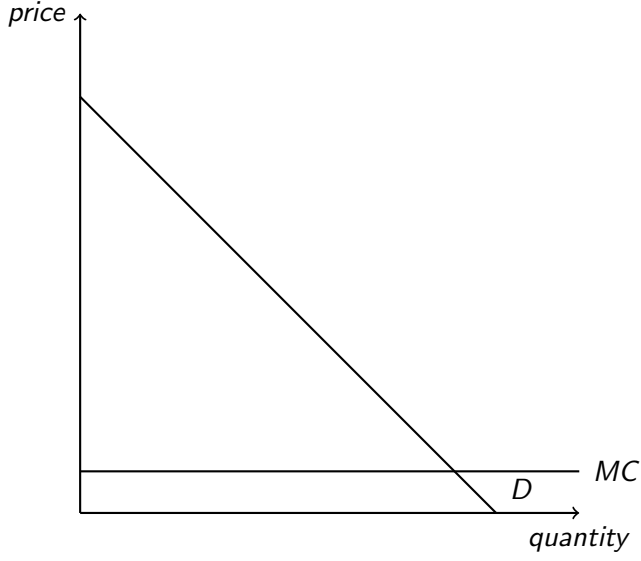
Pricing: MR=MC: algorithm

- Lets reiterate those steps again - follow this algorithm to find the optimal price for a monopolist given demand and marginal cost.

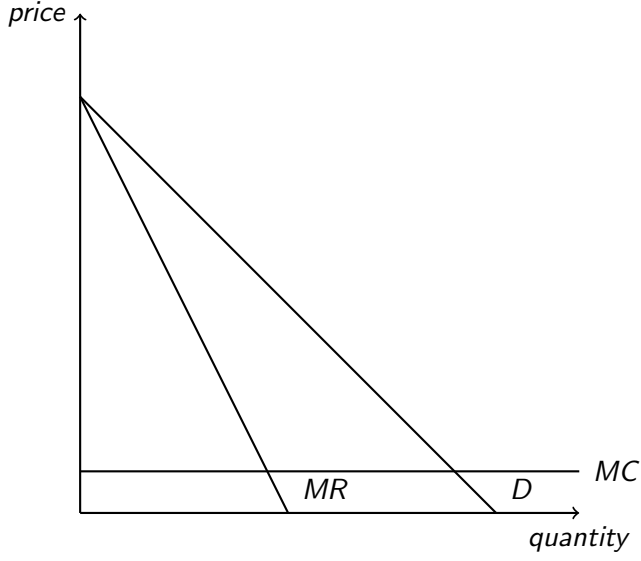
1. Get MR from the demand curve. (Use the 'double the slope' trick if demand is linear.)
2. Use MR=MC; solve for the optimal quantity
3. Plug the optimal quantity back into the demand curve to get the optimal price

- I'll now repeat these steps using a graphical analysis.

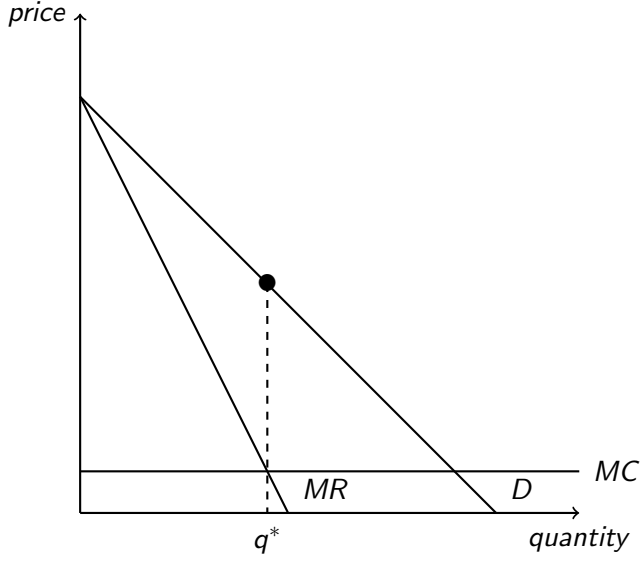
Pricing: MR=MC: graph



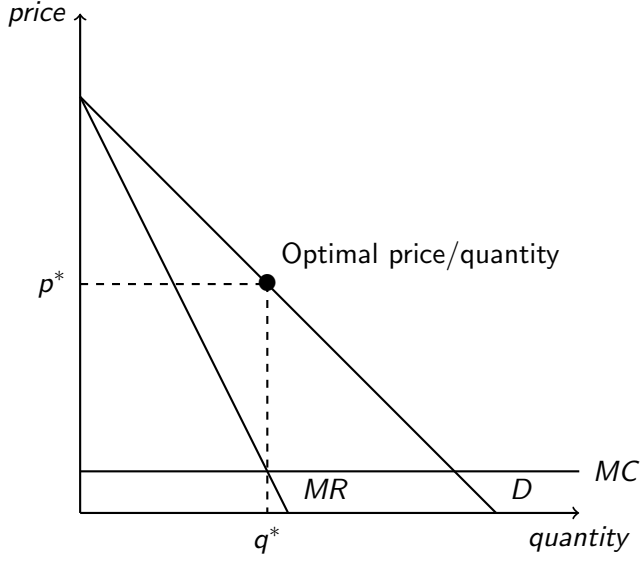
Pricing: MR=MC: graph 1. get MR from demand



Pricing: MR=MC: 2. Use MR=MC; get q^*



Pricing: MR=MC: 3. Get p^* from the demand curve.



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Elasticity rule

- There is a relationship between the optimal price and demand elasticity.
- This is known as the **elasticity rule**:

$$\underbrace{\frac{p - MC}{p}}_{\text{Margin}} = \underbrace{\frac{-1}{\epsilon}}_{\text{Inverse elasticity}}$$

- **Note:** divide by price on the left-hand-side not cost.
- Equivalently we can isolate the price on the left-hand-side:

$$p = \frac{MC}{1 + \frac{1}{\epsilon}}$$

Elasticity rule: math (optional)

- The elasticity rule comes from $MR = MC$. Let's unpack the math.

Elasticity rule: math (optional)

- The elasticity rule comes from $MR = MC$. Let's unpack the math.
- If the inverse demand curve is $p = P(q)$ then total revenue is:

$$TR = pq = P(q)q$$

- Marginal revenue is then (applying the product rule):

$$MR = \frac{dTR}{dq} = \frac{dP(q)q}{dq} = p + P'(q)q$$

- Now, setting MR = MC:

$$p + P'(q)q = MC$$

- Rearranging and applying $\epsilon = \frac{dq}{dp}\frac{p}{q}$:

$$\frac{p - MC}{p} = -P'(q)\frac{q}{p} = \frac{-1}{\epsilon}$$

Elasticity rule: $\frac{p-MC}{p} = \frac{-1}{\epsilon}$

- Let's check this rule holds for the example where we used $MR = MC$.

- Before, we showed that given demand $p = 10 - 5q$ and $MC = 5$, the optimal price is $p^* = 7.5$ and optimal quantity is $q^* = 0.5$.

Elasticity rule: $\frac{p-MC}{p} = \frac{-1}{\epsilon}$

- Let's check this rule holds for the example where we used $MR = MC$.
- Before, we showed that given demand $p = 10 - 5q$ and $MC = 5$, the optimal price is $p^* = 7.5$ and optimal quantity is $q^* = 0.5$.
  - Left-hand-side of the elasticity rule is: $\frac{p-MC}{p} = \frac{7.5-5}{7.5} = 1/3$
  - Right-hand-side of the elasticity rule requires computing the elasticity. First, rearrange demand so that $q = 2 - \frac{1}{5}p$. Then, the elasticity is:

$$\epsilon = \frac{dq}{dp}\frac{p}{q} = -\frac{1}{5} \times \frac{7.5}{0.5} = -3$$

  - So, right-hand-side $= \frac{-1}{\epsilon} = \frac{-1}{-3} = 1/3 =$ left-hand-side
  - So, the elasticity rule works!

Using the elasticity rule

- Why is the elasticity rule a useful way to think about optimal prices?
- It turns out it is really useful for real-world empirical applications. Why?

Using the elasticity rule

- Why is the elasticity rule a useful way to think about optimal prices?
- It turns out it is really useful for real-world empirical applications. Why?
  - For example, suppose you are working as an economist in a firm and you are trying to optimally price a product.
  - Typically, you will know the MC. You can (using econometric methods which outside the scope of this course) find the demand elasticity.
  - Then just plug MC and demand elasticity into the elasticity rule to get the optimal price.

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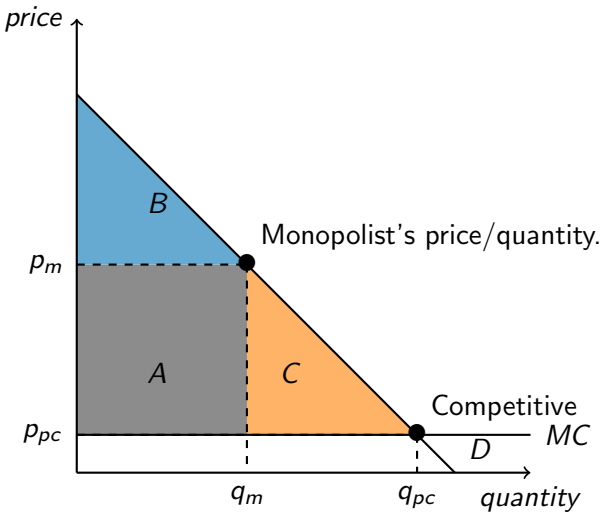
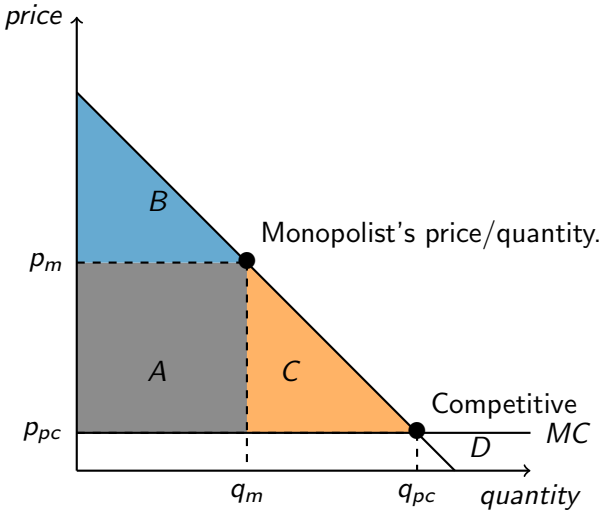
4. **Welfare costs of monopoly pricing and regulation**

Welfare costs of monopoly pricing



Welfare costs of monopoly pricing



- Here's the diagram from before with the competitive price/quantity (this is where MC=D and is denoted by q_{pc}, p_{pc}
- Area A: Producer surplus (equal to total profit if fixed costs=0)
- Area B: Consumer surplus
- Monopoly sets price 'too high' and quantity 'too low' compared to the competitive case. This causes a dead-weight-loss: Area C

Welfare costs of monopoly pricing: summary

- Competition would result in prices that maximize **total surplus**
- Monopolist sets prices 'optimally' (i.e. optimal for itself) and maximizes **profit**
- The monopolist ends up setting a price 'too high' and a quantity 'too low' compared to competition.
- The difference in total surplus between a monopolist and competition is called the **dead-weight-loss**.
- Monopoly is an example of a **market failure**.

Regulating monopolies

- How can we correct the market failure of a monopoly and increase total surplus/reduce dead-weight-loss?
- One option: break up the monopoly into smaller firms that compete with each other.
- This is an example of **antitrust policy** (policies that correct market failure due to a lack of competition)

Regulating monopolies: case study of Facebook vs FTC

- **Background:**
- In 2012 Facebook acquired Instagram
- In 2014 Facebook acquired Whatsapp

Regulating monopolies: case study of Facebook vs FTC

- In 2020 the Federal Trade Commission (FTC) sued Facebook.
- FTC was seeking to (amongst other things) require **divestiture** (the forced sale) of Whatsapp and Instagram.
- FTC alleged "Facebook has engaged in a systematic strategy [of acquisitions]... to eliminate threats to its monopoly"
  - FTC: "Facebook's actions to entrench and maintain its monopoly deny consumers the benefits of competition."

Regulating monopolies: case study of Facebook vs FTC

- **Outcome:** Court dismissed the FTC's complaint in June 2021.
- Court stated that FTC did not prove that Facebook was a monopoly.
- In addition, court argued that FTC waited too long to challenge the acquisitions.
- The court allowed Facebook to refile at a future date with more evidence that Facebook is a monopoly.

Regulating monopolies: other examples of breaking up a monopoly

- Standard Oil: enormous oil company run by John D. Rockefeller.
- Standard Oil was broken up into companies including Chevron, ExxonMobil, and Amoco at the start of the 20th century.
- AT&T: Broken up into many smaller firms in 1984
- There are many other examples of monopoly breakups, as well as attempted breakups (e.g. Microsoft in 2001)
- That said, as we will see in Part 3 of the course, much of antitrust policy is focused on *preventing* new monopolies.

Regulating monopolies: marginal and average cost pricing

- Sometimes it is not possible to break up the monopoly into smaller firms.
    - Examples: a power plant, a bridge
- These are known as **'natural monopolies'**
- How should we regulate these monopolies?

Regulating monopolies: marginal cost pricing

- One possibility for regulation: **marginal cost pricing**
- **Idea**: force the monopolist to set $p = MC$
  - This is the perfect competition price and so there will be no dead-weight-loss.
- **But there is an issue.** Suppose that the monopolist has a cost function of $C(q) = F + cq$ where F is a fixed cost and c is the constant marginal cost.

Regulating monopolies: marginal cost pricing

- One possibility for regulation: **marginal cost pricing**
- **Idea**: force the monopolist to set $p = MC$
  - This is the perfect competition price and so there will be no dead-weight-loss.
- **But there is an issue.** Suppose that the monopolist has a cost function of $C(q) = F + cq$ where F is a fixed cost and c is the constant marginal cost.
- Then, the monopolists profit will be:

$$Profit = TR - TC = pq - F - cq$$

- Since $p = MC = c$, the monopolists profit will be $-F$ i.e. negative!
- Clearly, this firm would **shutdown** under regulation because profit is negative. To prevent firm shutdown, a possibility is to also give the firm a **government subsidy of** F.

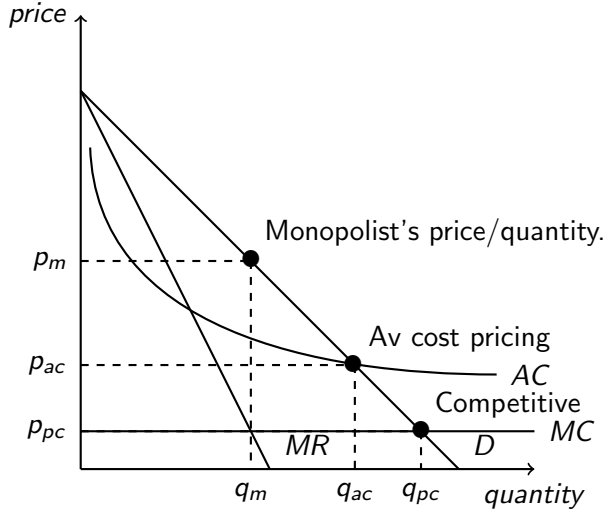
Regulating monopolies: average cost pricing

- Another possibility for regulation: **average cost pricing**
- **Idea**: force the monopolist to set $p = AC$. This is the price consistent with the monopolist making zero profits:
  - If $Profit = 0$ then, equivalently, $TR = TC$.
  - Since $TR = pq$, $TR = TC$ is equivalent to $pq = TC$.
  - Rearranging: $p = TC/q = AC$

Regulating monopolies: average cost pricing

- Essentially, average cost pricing allows the monopolist to exercise its monopoly power only to cover its fixed costs.
    - So, a government subsidy is no longer necessary.
- Average cost pricing is commonly used to regulate privately owned power plants in the US and many other countries and in this context it is called 'rate of return regulation'.
- We will now see average cost pricing on the previous monopoly graph.

Regulating monopolies: average cost pricing



- Diagram from before with average cost pricing (quantity $= q_{ac}$, price $= p_{ac}$)

Summary of key points*

- Know the optimal price occurs at $MR = MC$ (where 'optimal price' means the profit maximizing price)
- Know the steps to solve for the monopolist's optimal price and compute the dead-weight-loss, graphically and using math
- Know the elasticity rule
- Know three potential solutions to monopoly market failure (and how to apply them): 1. divestment 2. marginal cost pricing 3. average cost pricing.

*To clarify, all the material in the slides, problem sets, etc is assessable unless stated otherwise, but I hope this summary might be a useful place to start when studying the material.

References

- Monopoly graph based on:
`https://github.com/EconoTodd/LaTeX_code/blob/master/naturalmonopoly`