Monopoly

ECON 370: Microeconomic Theory

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Monopoly

- market with a single seller
- Firm demand = market demand
- Firm demand is downward sloping
- Monopolist can alter market price by adjusting its own output level

Causes of Monopolies

- Created by law ⇒ US Postal Service
- a patent ⇒ a new drug
- sole ownership of a resource ⇒ a toll highway
- formation of a cartel ⇒ OPEC
- large economies of scale ⇒ local utility company (natural monopoly)

Profit Maximization

- We assume profit maximization
- Earlier we noted
  - profit maximization ⇒
  - Marginal Revenue = Marginal Cost
- With monopolies, that is the relevant test

Mathematically

$$\pi(y) = p(y)y - c(y)$$

At profit-maximizing output y*:

$$\frac{d\pi(y)}{dy} = \frac{d}{dy}(p(y)y) - \frac{dc(y)}{dy} = 0$$

$$p(y) + \frac{dp(y)}{dy}y = \frac{dc(y)}{dy}$$

Significance

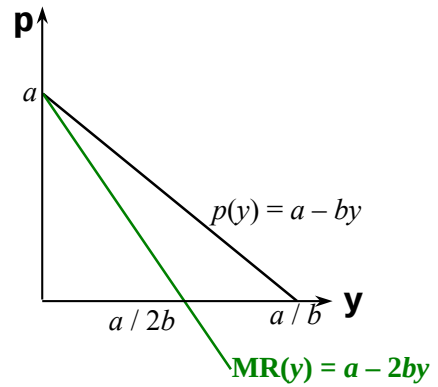
$$p(y) + \frac{dp(y)}{dy}y = \frac{dc(y)}{dy}$$

- Since demand is downward sloping: dp/dy < 0
  - So a monopoly supplies less than a competitive market would
  - At a higher price
- MR < Price because to sell the next unit of output it has to lower its price on ***all*** its product
  - Not just on the last unit
  - Thus further reducing revenue

Linear Demand

- If demand is $q(p) = f - gp$
- Then the inverse demand function is
  - $p = f/g - q/g$
  - Let $a = f/g$, and
  - Let $b = 1/g$
  - Then $p = a - bq$
- Since output y = demand q, the revenue function is
  - $p(y) \cdot y = (a - by)y = ay - by^2$
- Marginal Revenue is
  - MR = $a - 2by$

Linear Demand Graph



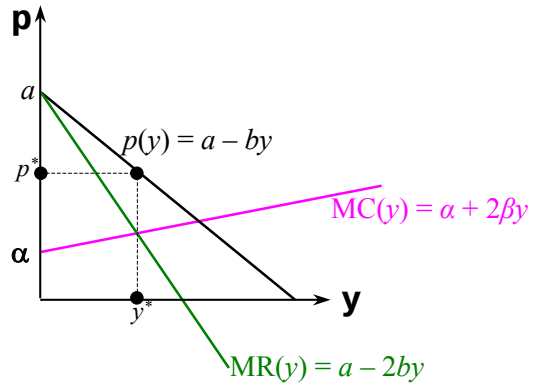
Profit-Maximization: An Example

- Linear Demand: $p(y) = a - by$
- Cost function $c(y) = F + \alpha y + \beta y^2$
  - So, MC = $\alpha + 2\beta y$
- At profit maximizing y^*, MR = MC, So
  - $a - 2by = \alpha - 2\beta y$

$$y^* = \frac{a-\alpha}{2(b+\beta)}$$

$$p\left(y^*\right) = a - by^* = a - b\frac{a-\alpha}{2(b+\beta)}$$

Graphically



Elasticity and Monopolistic Pricing

$$MR(y) = p(y) + y\frac{dp(y)}{dy} = p(y)\left[1 + \frac{y}{p(y)}\frac{dp(y)}{dy}\right]$$

Since Own-price elasticity of demand is

$$\varepsilon = \frac{p(y)}{y}\frac{dy}{dp(y)}$$

Then $MR(y) = p(y)\left[1 + \frac{1}{\varepsilon}\right]$

Elasticity and Monopolistic Pricing 2

Since MR = MC, then

$$p\left(y^*\right)\left[1 + \frac{1}{\varepsilon}\right] = MC\left(y^*\right)$$

In particular, note that:

$$p\left(y^*\right)\left[1 + \frac{1}{\varepsilon}\right] \geq 0 \quad \Rightarrow \quad 1 + \frac{1}{\varepsilon} \geq 0 \quad \Rightarrow \quad \varepsilon \leq -1$$

Markup Pricing

- One Interpretation of the elasticity results is *Markup pricing*
  - Output price = MC + "markup"
- Issues
  - How big is a monopolist's markup?
  - How does it change with the own-price elasticity of demand?

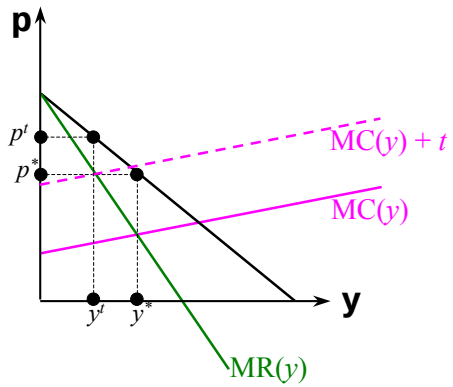
Pure Profits Tax Levied on a Monopoly

- Pure profits tax levied at rate t
  - Reduces profit from $\pi(y^*)$ to $(1 - t)\pi(y^*)$
  - Monopolist maximizes after-tax profit, $(1 - t)\pi(y^*)$
  - Same as maximizing before-tax profit, $\pi(y^*)$
- Implications
  - Profits tax has no effect on monopolist's choices of output, price or input demands
  - The profits tax is a neutral tax

Quantity Tax Levied on a Monopolist

- A quantity tax of \$$t$ per output unit
  - Raises the marginal cost of production by \$$t$
  - Reduces profit-maxing output
  - Causes market price to rise
  - Input demands to fall
- The quantity tax is *distortionary*

Quantity Tax Graph



Tax impact on Consumers

- Can a monopolist "shift" all of a $t quantity tax to consumers?
- Suppose MC= k (constant)
- With no tax (MR=MC=k): $p(y^*) = \frac{k\varepsilon}{1+\varepsilon}$
- Tax increases MC to (k+t), changing profit-maximizing price (MR=MC=k+t) to

$$p(y^t) = \frac{(k+t)\varepsilon}{1+\varepsilon}$$

- The amount of tax shifted to buyers is: $p(y^t) - p(y^*)$

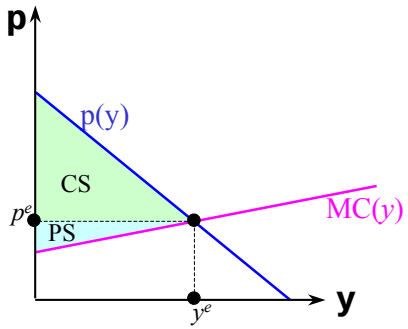
Tax impact on Consumers

$$p(y^t) - p(y^*) = \frac{(k+t)\varepsilon}{1+\varepsilon} - \frac{k\varepsilon}{1+\varepsilon} = \frac{t\varepsilon}{1+\varepsilon}$$

- is amount of tax shifted to buyers.
- E.g. if ε = -2, amount of tax shifted is $2t$
- In general, if ε < -1 (always true for monopolist)
  - ε /(1 + ε) > 1, and
  - monopolist **passes on more than the tax**!

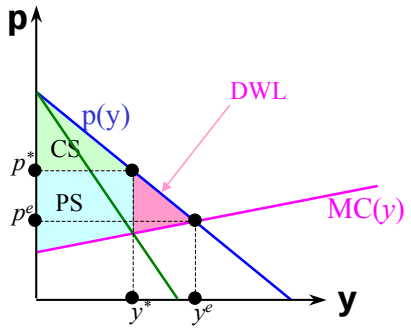
Inefficiency of Monopoly: Graph

- Efficient output level y^e satisfies $p(y) = MC(y)$
- Total gains-from-trade are maximized



Inefficiency of Monopoly: Graph

- Both buyer and seller could gain from production of one more unit…so Pareto Inefficient



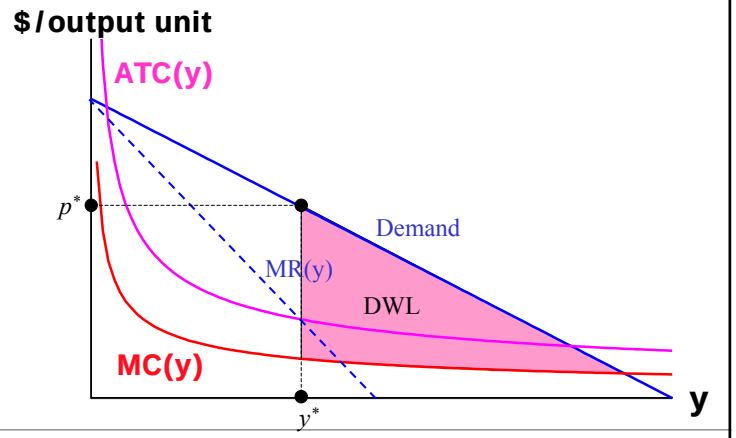
Regulating Monopolies Generally

- Licensing (patents)
- Antitrust Remedies
  - Conduct Remedies
  - Structural Remedies
- Regulation (especially *natural monopolies*)
- Considerations
  - Firm must be allowed to earn profit ≥ 0
  - A Firm will use private information to its own advantage
  - Law of unintended consequences

Natural Monopoly: Introduction

- Natural monopoly
  - Technology has very large economies-of-scale
  - Firm can supply whole market at lower average total cost than possible with more than one firm

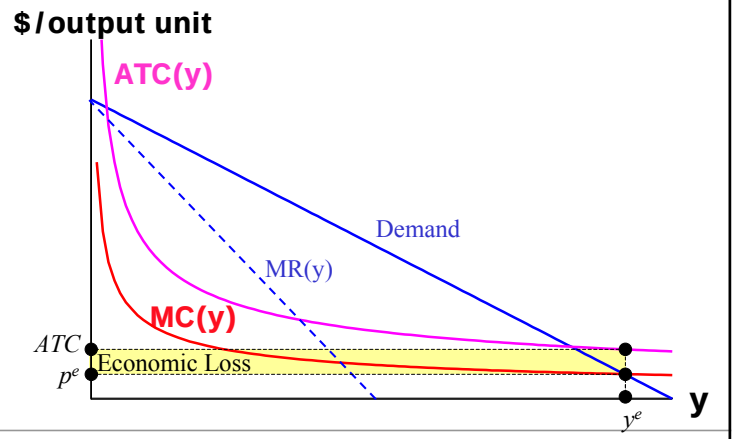
Natural Monopoly: Graph



Regulating a Natural Monopoly: Intro

- Problem facing regulators
  - Want efficient output (p = MC)
  - Want DWL = 0
  - But impossible with natural monopoly
- At efficient output y^e, ATC(y^e) > p(y^e)
- Regulated monopoly has an economic loss

Regulating a Natural Monopoly: Graph



Regulating a Natural Monopoly

- Natural monopoly cannot use p = MC
  - If so, profit is < 0
  - Monopolist will exit
  - Destroys both the market and any gains-to-trade
- Regulatory schemes induce natural monopolist to produce the efficient output w/o exiting

Alternative Forms of Monopoly Pricing

- Uniform pricing – single price to all customers
- Price-discrimination
  - Charge different prices to different customers
  - Requires different markets w/ no trade
  - Also requires different elasticities
  - Can only raise profits (or get same)

Types of Price Discrimination

- 1st-degree
  - Each output unit is sold at a different price
  - Prices differ across buyers
- 2nd-degree
  - Price varies with quantity demanded by buyer
  - All customers face the same price schedule
- 3rd-degree price discrimination
  - Price paid by buyers in group is same for all units
  - Price differs across buyer groups
    - senior citizen discounts
    - student discounts
    - no discounts for middle-aged persons

1st-degree Price Discrimination: Intro

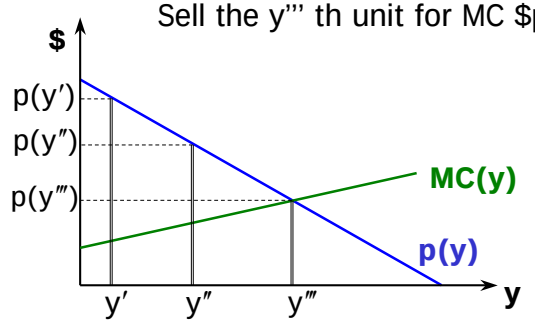
- Each output unit is sold at a different price
- Requires that monopolist can discover
  - the buyer w/ the highest valuation of its product
  - the buyer w/ the next highest valuation
  - Etc., etc., etc.

1st-degree Price Discrimination: Graph

Sell the y'th unit for $p(y')

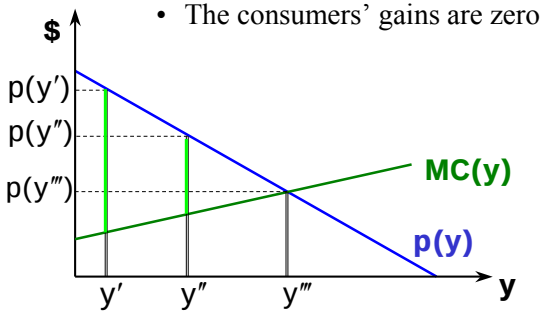
Sell the y''th unit for $p(y'')

Sell the y''' th unit for MC $p(y''')



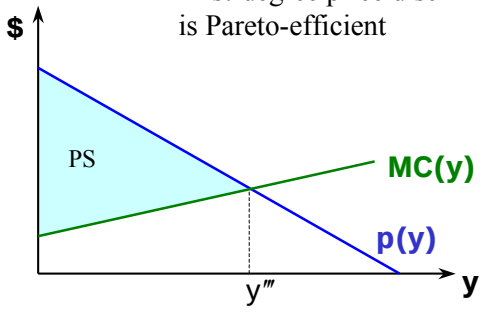
1st-degree Price Discrimination: Graph

- Gains to monopolist on these trades are: p(y´) – MC(y´), p(y´´) – MC(y´´), and zero
- The consumers' gains are zero



1st-degree Price Discrimination: Graph

- The monopolist gets the maximum possible gains from trade
- First-degree price discrimination is Pareto-efficient



1st-degree Price Discrimination: Summary

- First-degree price discrimination
  - gives monopolist all possible gains-to-trade
  - leaves buyers with zero consumer surplus
  - supplies efficient amount of output

2nd Degree Price Discrimination

- 2nd Degree Price discrimination includes
- 2-part tariffs
- Volume Discounts
- Fixed Price-Quantity bundles
  - For example, mobile-phone service is sold this way

Two-part tariffs

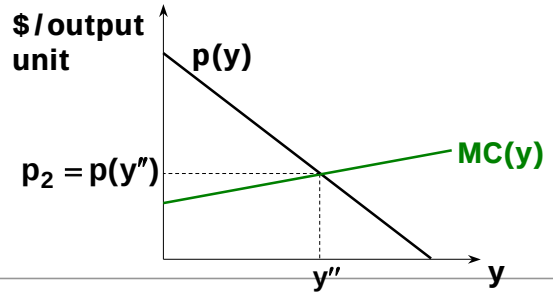
- Two-part tariff
  - lump-sum fee p_1 plus
  - price p_2 for each unit purchased
- Thus the cost of buying x units of product is
- $p_1 + p_2 x$

Two-Part Tariffs: Entrance Fee

- Two part tariff: $p_1 + p_2 x$
- What p_1? is maximum entrance fee = p_1?
- Maximum p_1 = surplus buyer gains from entering the market
- So, monopolist strategy:
  - Set p_1 = CS
  - Solve for optimal p_2

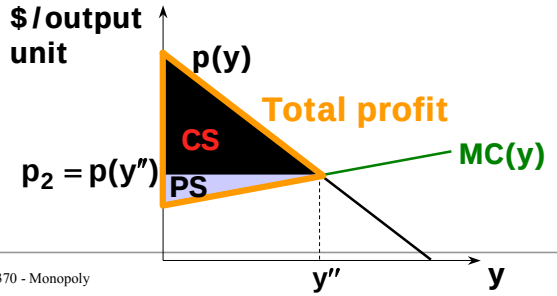
Two-Part Tariffs: Graph

Should the monopolist set p_2 = MC?



Two-Part Tariffs: Graph

Should the monopolist set p_2 = MC?
p_1 = CS
PS is profit from sales



Two-Part Tariffs: Maximizing Profits

- Monopolist maximizes profit w/ two-part tariff
  - setting unit price p_2 = marginal cost and
  - setting its lump-sum entrance fee p_1 equal to Consumers' Surplus at output where p_2 = MC
- Monopolist gets all gains from trade
- Outcome is efficient

3rd-degree Price Discrimination

- Price paid by buyers in a given group is the same for all units purchased
- Price may differ across buyer groups (if demand elasticities are different)
- Monopolist manipulates price by altering quantity supplied to each market
- How many units of product will the monopolist supply to each group?

3rd-degree Price Discrimination

- Two markets, 1 and 2
- y_1 = quantity supplied to market 1
- $p_1(y_1)$ = inverse demand function in market 1
- y_2 = quantity supplied to market 2
- $p_2(y_2)$ = inverse demand function in market 2

3rd-degree Price Discrimination: Profit

- For given supply levels y_1 and y_2 the firm's profit is
- $\pi(y_1, y_2) = p_1(y_1)y_1 + p_1(y_2)y_2 - c(y_1 + y_2)$
- What values of y_1 and y_2 maximize profit?

Profit Maximization

$$\pi(y_1, y_2) = p_1(y_1)y_1 + p_2(y_2)y_2 - c(y_1 + y_2)$$

The profit-maximization condition is

$$\frac{\partial \pi}{\partial y_i} = \frac{\partial}{\partial y_i}(p_i(y_i)y_i) - \frac{\partial c(y_1 + y_2)}{\partial (y_1 + y_2)} \times \frac{\partial (y_1 + y_2)}{\partial y_i} = 0$$

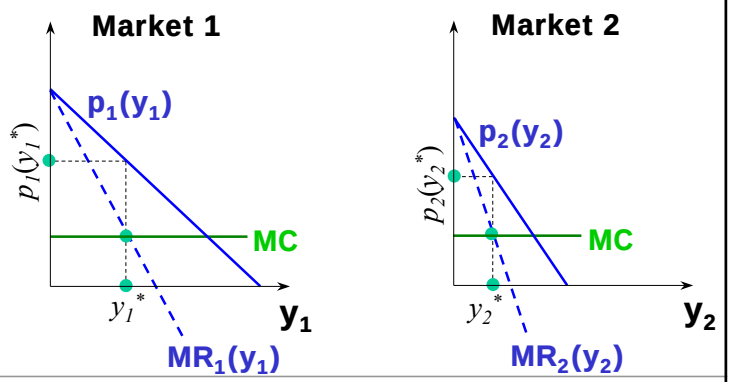
$$\Rightarrow MR_i(y_i) = MC(y_1 + y_2)$$

Implications

- $MR_i(y_i) = MC(y_1 + y_2)$
- Implies that
  - $MR_1 = MR_2 = MC$
  - If marginal $MR_1 > MR_2$, then a unit of output should be moved from market 2 to market 1
  - (why?)

3rd-degree Price Discrimination: Graph

$MR_1(y_1^*) = MR_2(y_2^*) = MC$



Theory of Monopolistic Competition

- Monopolistic Competition
  - Elements of monopoly
  - Elements of perfect competition
- Monopoly Elements
  - Each firm faces downward sloping demand
  - (Less than perfect substitutes)
  - Product differentiation
    - Trademarks
    - Advertising

Theory of Monopolistic Competition

- Competitive element
  - Free entry
  - Zero profit in long run
  - Firms compete in price and quantity, product features (product differentiation)
- Behavioral Assumption
  - Profit maximization, given downward sloping demand curve

Theory of Monopolistic Competition

- Equilibrium
  - Each firm on its own demand curve
  - Free entry implies zero long run profits
- Characteristics
  - Firms produce to left of LRAC minimum point
  - Firms have “excess capacity”
  - Firms spend money on product differentiation (actual and specious)
  - But consumers get more product diversity

Analysis of Factor Markets

- Competitive firms factor demands
- Monopolist factor demands
- Assume:
  - Output price p_y
  - Production Function $y = F(x_1, x_2)$
  - Prices p_1, p_2 for inputs x_1, x_2 respectively
- We will analyze the firm's demand curve for x_1
  - as price p_1 varies
  - Holding other prices constant

Input Demands

- Competitive firm is price-taker in its output and input markets
- Since Profit = Revenue – Cost
  - i.e., $\pi = R - C$
- Profit Maximization implies:

$$\frac{\partial \pi}{\partial x_1} = \frac{\partial R}{\partial x_1} - \frac{\partial C}{\partial x_1} = 0 \quad \Rightarrow \quad \frac{\partial R}{\partial x_1} = \frac{\partial C}{\partial x_1}$$

- dR/dx_1 is the Marginal Revenue Product (MRP_1)
  - Which we rewrite as:
  - $MRP_1 = dR/dx_1 = (dR/dy)(dy/dx_1) = MR \times MP_1$

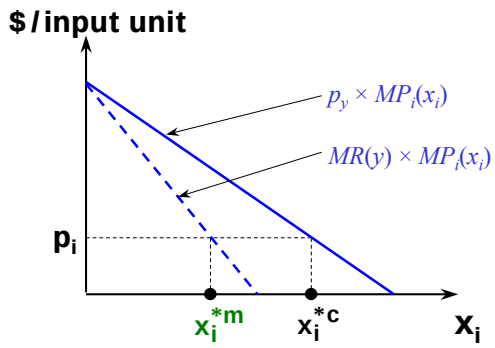
Competitive Firm's Input Demands

- For all firms: $MRP_i = MR \times MP_i = \dfrac{\partial C}{\partial x_1}$
- For the competitive firm the marginal revenue of a unit of input i is p_y
- And it treats input prices as given,
  - so Cost $C = p_1 x_1 + p_2 x_2$
- Therefore $\dfrac{\partial C}{\partial x_1} = p_1$
- And $MRP_i = p_y MP_i = p_1$

Monopolist's Input Demands

- If the firm is monopolist in output market, but price-taker in its input markets
- Then $MRP_i = MR(y) \times MP_i = p_1$
- Since, $MR(y) < p_y$ for all y
  - Then in general, a monopoly will demand less input than a similarly situated competitive firm

Monopolist's Demands for Inputs: Graph



Monopsonist's Input Demands

- Assume the firm has no pricing power in output market,
  - but is the sole buyer in its input markets
- Assume the seller's side of the market is perfectly competitive
- Then: $MRP_i = p_y MP_i = \frac{dC}{dx_1} = \frac{d}{dx_1}[p(x_1)x_1 + p_2 x_2]$

$$p_y MP_i = \frac{dp(x_1)}{dx_1}x_1 + p(x_1) = \left[\frac{dp(x_1)}{dx_1}\frac{x_1}{p(x_1)} + 1\right]p(x_1)$$

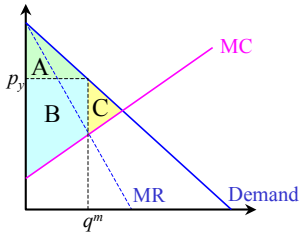
$$p_y MP_i = \left[\frac{1}{\eta} + 1\right]p(x_1)$$

Monopoly v. Monopsony

Monopoly	Monopsony
Decision Basis	
MR = MC	Marginal Benefit (MB) = MC *(Where MB = MRP)*
$p_y\left[1+\frac{1}{\varepsilon}\right] = MC$	$p_i\left[1+\frac{1}{\eta}\right] = MRP_i$

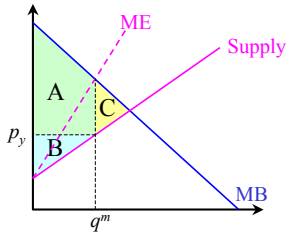
Monopoly v. Monopsony (cont)

Monopoly



A = Consumer Surplus
B = Producer Surplus
C = DWL

Monopsony



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