MICROECONOMICS

Principles and Analysis

MONOPOLY

WHAT IS MONOPOLY?

- Consider a simple model of market power
  - One seller, multiple buyers
  - Buyers act as price-takers
  - Seller determines price
- An artificial construct?
  - What prevents there being other firms in the industry?
  - Or other firms that could potentially replace this firm?
  - Or firms producing very close substitutes?
  - Assume monopoly position is guaranteed by an exogenous factor (the law?)
- Here we will examine:
  - ...monopoly with different types of market power
  - ... the relationship with competitive market equilibrium
  - A useful baseline case for more interesting models of the market
- Begin with an elementary model...

OVERVIEW...

An elementary extension of profit maximisation

- Monopoly
  - **Simple model**
  - Exploitation
  - Discriminating monopolist
  - Product diversity

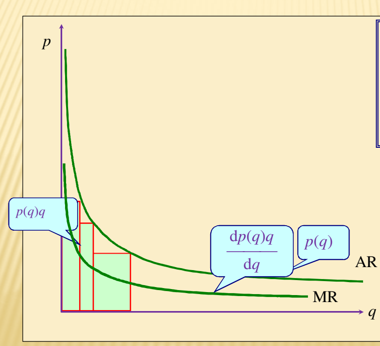
A SIMPLE PRICE-SETTING FIRM

- Contrast with the price-taking firm:
- Output price is no longer exogenous
- We assume a determinate demand curve
- No other firm's actions are relevant
- Profit maximisation is still the objective

MONOPOLY – MODEL STRUCTURE

- We are given the *inverse demand function*:
  - $p = p(q)$
  - Gives the (uniform) price that would rule if the monopolist chose to deliver q to the market.
  - For obvious reasons, consider it as the *average revenue curve* (AR).
- Total revenue is:
  - $p(q)q$.
- Differentiate to get monopolist's *marginal revenue* (MR):
  - $p(q)+p_q(q)q$
  - $p_q(\bullet)$ means $dp(\bullet)/dq$
- Clearly, if $p_q(q)$ is negative (demand curve is downward sloping), then MR < AR.

AVERAGE AND MARGINAL REVENUE



- *AR curve is just the market demand curve...*
- *Total revenue: area in the rectangle underneath*
- *Differentiate total revenue to get marginal revenue*

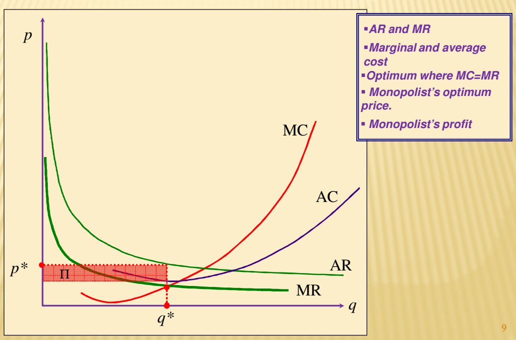
MONOPOLY – OPTIMISATION PROBLEM

- Introduce the firm's cost function $C(q)$.
  - Same basic properties as for the competitive firm.
- From C we derive marginal and average cost:
  - MC: $C_q(q)$.
  - AC: $C(q) / q$.
- Given $C(q)$ and total revenue $p(q)q$ profits are:
  - $\Pi(q) = p(q)q - C(q)$
- The shape of Π is important:
  - We assume it to be differentiable
  - Whether it is concave depends on both $C(\bullet)$ *and* $p(\bullet)$.
  - Of course $\Pi(0) = 0$.
- Firm maximises $\Pi(q)$ subject to $q \geq 0$.

MONOPOLY – SOLVING THE PROBLEM

- Problem is "max $\Pi(q)$ s.t. $q \geq 0$, where:
  - $\Pi(q) = p(q)q - C(q)$.
- First- and second-order conditions for *interior* maximum:
  - $\Pi_q(q) = 0$.
  - $\Pi_{qq}(q) < 0$.
- Evaluating the FOC:
  - $p(q) + p_q(q)q - C_q(q) = 0$.
- Rearrange this:
  - $p(q) + p_q(q)q = C_q(q)$
  - "Marginal Revenue = Marginal Cost"
- This condition gives the solution.
  - From above get optimal output q^*.
  - Put q^* in $p(\bullet)$ to get monopolist's price:
  - $p^* = p(q^*)$.

MONOPOLIST'S OPTIMUM



MONOPOLY – PRICING RULE

- Introduce the *elasticity of demand* η:
  - $\eta := d(\log q) / d(\log p)$
  - $= q p_q(q) / p$
  - $\eta < 0$
- First-order condition for an interior maximum
  - $p(q) + p_q(q)q = C_q(q)$
- ...can be rewritten as
  - $p(q)\ [1+1/\eta] = C_q(q)$
- This gives the monopolist's pricing rule:
  - $p(q) = \dfrac{C_q(q)}{1 + 1/\eta}$

MONOPOLY – THE ROLE OF DEMAND

- Suppose demand were changed to
  - $a + bp(q)$
  - a and b are constants.
- Marginal revenue and demand elasticity are now:
  - $MR(q) = bp_q(q)\, q + [a + bp(q)]$
  - $\eta = [a/b + bp(q)] / p_q(q)$
- Rotate the demand curve around (p^*, q^*).
  - $db>0$ and $da = - p(q^*)\, db < 0$.
  - Price at q^* remains the same.
  - Marginal revenue at q^* increases – $dMR(q^*) > 0$.
  - Abs value of elasticity at q^* decreases – $d|\eta| < 0$.
  - But what happens to optimal output?
- Differentiate FOC in the neighbourhood of q^*:
- $dMR(q^*)db + \Pi_{qq}\ dq^* = 0$
- So $dq^* > 0$ if $db>0$.

MONOPOLY – ANALYSING THE OPTIMUM

- Take the basic pricing rule
  - $p(q) = \dfrac{C_q(q)}{1 + 1/\eta}$
- Use the definition of demand elasticity
  - $p(q) \geq C_q(q)$
  - $p(q) > C_q(q)$ if $|\eta| < \infty$.
  - "price > marginal cost"
- Clearly as $|\eta|$ decreases :
  - output decreases
  - gap between price and marginal cost increases.
- What happens if $\eta \geq -1$?

WHAT IS GOING ON?

- To understand why there may be no solution consider two examples
- A firm in a competitive market: $\eta = -\infty$
  - $p(q) = \bar{p}$
- A monopoly with inelastic demand: $\eta = -\frac{1}{2}$
  - $p(q) = aq^{-2}$
- Same quadratic cost structure for both:
  - $C(q) = c_0 + c_1 q + c_2 q^2$
- Examine the behaviour of $\Pi(q)$

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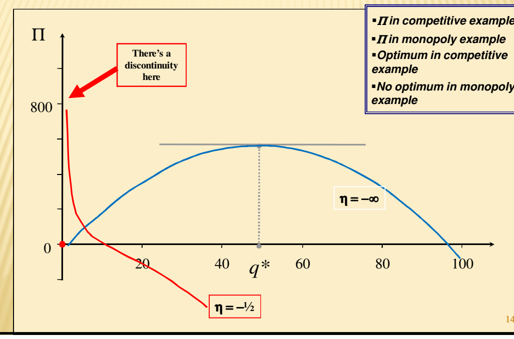
PROFIT IN THE TWO EXAMPLES



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THE RESULT OF SIMPLE MARKET POWER

- There's no supply curve:
  - For competitive firm market price is sufficient to determine output.
  - Here output depends on *shape* of market demand curve.
- Price is artificially high:
  - Price is above marginal cost
  - Price/MC gap is larger if demand is inelastic
- There may be no solution:
  - What if demand is very inelastic?

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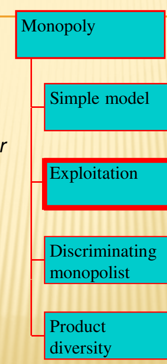
OVERVIEW...

increased power for the monopolist?



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COULD THE FIRM HAVE MORE POWER?

- Consider how the simple monopolist acts:
  - Chooses a level of output q
  - Market determines the price that can be borne $p = p(q)$
  - Monopolist sells *all* units of output at this price p
- Consumer still makes some gain from the deal
  - Consider the total amount bought as separate units
  - The *last* unit (at q) is worth exactly p to the consumer
  - Perhaps would pay more than p for previous units (for $x < q$)
- What is total gain made by the consumer?
  - This is given by area under the demand curve and above price p
  - Conventionally known as *consumer's surplus*

$$\int_0^q p(x)\,dx - pq$$

- Use this to modify the model of monopoly power...

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THE FIRM WITH MORE POWER

- Suppose monopolist can charge for the right to purchase
  - Charges a fixed "entry fee" F for customers
  - Only works if it is impossible to resell the good
- This changes the maximisation problem
  - Profits are now

    $F + pq - C(q)$

    where $F = \int_0^q p(x)\,dx - pq$
  - which can be simplified to

    $\int_0^q p(x)\,dx - C(q)$
- Maximising this with respect to q we get the FOC

  $p(q) = C_q(q)$
- This yields the optimum output...

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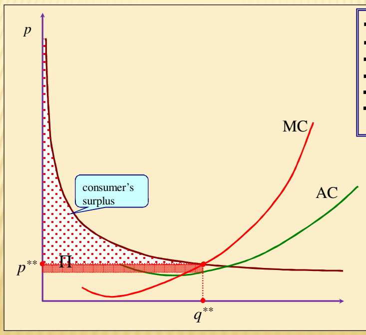
MONOPOLIST WITH ENTRY FEE



- *Demand curve*
- *Marginal cost*
- *Optimum output*
- *Price*
- *Entry fee*
- *Monopolist's profit*

- *Profits include the rectangle and the area trapped between the demand curve and p***

MONOPOLIST WITH ENTRY FEE

- We have a nice result
  - Familiar FOC
  - Price = marginal cost
- Same outcome as perfect competition?
- No, because consumer gets no gain from the trade
  - Firm appropriates all the consumer surplus through entry fee

OVERVIEW...

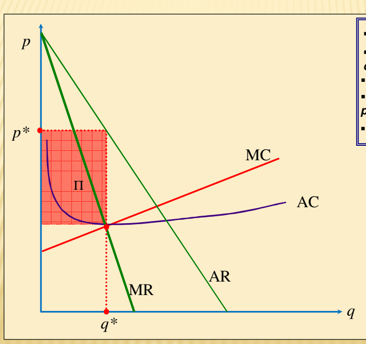
Monopolist working in many markets

- Monopoly
  - Simple model
  - Exploitation
  - **Discriminating monopolist**
  - Product diversity

MULTIPLE MARKETS

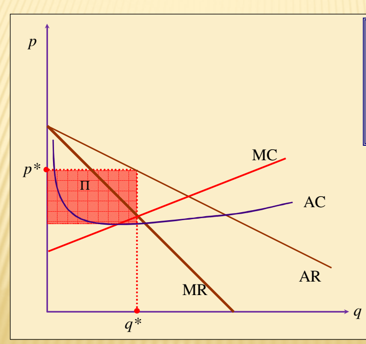
- Monopolist sells same product in more than one market
  - An alternative model of increased power
  - Perhaps can discriminate between the markets
- Can the monopolist separate the markets?
  - Charge different prices to customers in different markets
  - In the limit can see this as similar to previous case...
  - ...if each "market" consists of just one customer
- Essentials emerge in two-market case
- For convenience use a simplified linear model:
  - Begin by reviewing equilibrium in each market in isolation
  - Then combine model....
  - ...how is output determined...?
  - ...and allocated between the markets

MONOPOLIST: MARKET 1 (ONLY)



- *AR and MR*
- *Marginal and average cost*
- *Optimum where MC=MR*
- *Monopolist's optimum price.*
- *Monopolist's profit*

MONOPOLIST: MARKET 2 (ONLY)



- *AR and MR*
- *Marginal and average cost*
- *Optimum where MC=MR*
- *Monopolist's optimum price.*
- *Monopolist's profit*

MONOPOLY WITH SEPARATED MARKETS

- Problem is now "max $\Pi(q^1, q^2)$ s.t. $q^1, q^2 \geq 0$, where:
  - $\Pi(q^1, q^2) = p^1(q^1)q^1 + p^2(q^2)q^2 - C(q^1 + q^2)$.
- First-order conditions for interior maximum:
  - $\Pi_i(q^1, q^2) = 0$, $i = 1, 2$
  - $p^1(q^1)q^1 + p^1_q(q^1) = C_q(q^1 + q^2)$
  - $p^2(q^2)q^2 + p^2_q(q^2) = C_q(q^1 + q^2)$
- Interpretation:
  - "Market 1 MR = MC overall"
  - "Market 2 MR = MC overall"
  - So output in each market adjusted to equate MR
- Implication
  - Set price in each market according to what it will bear
  - Price higher in low-elasticity market

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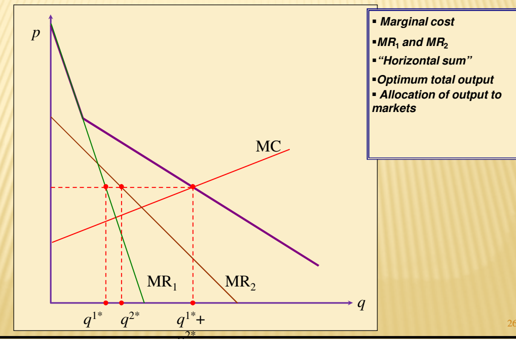
OPTIMUM WITH SEPARATED MARKETS



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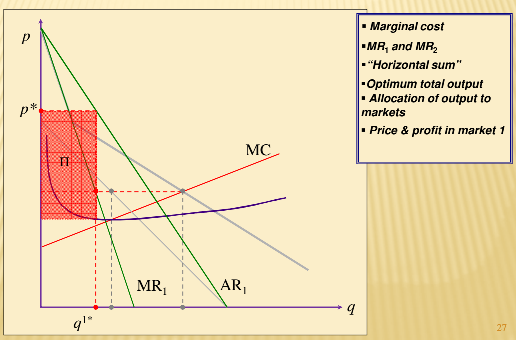
OPTIMUM WITH SEPARATED MARKETS



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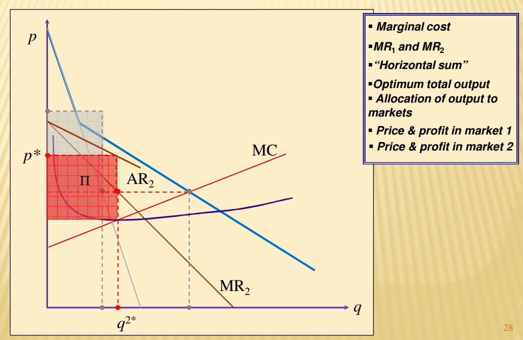
OPTIMUM WITH SEPARATED MARKETS



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MULTIPLE MARKETS AGAIN

- We've assumed that the monopolist can separate the markets
- What happens if this power is removed?
  - Retain assumptions about the two markets
  - But now require same price
- Use the standard monopoly model
  - Trick is to construct combined AR...
  - ...and from that the combined MR

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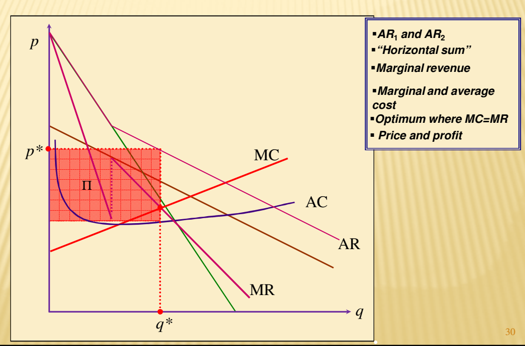
TWO MARKETS: NO SEPARATION



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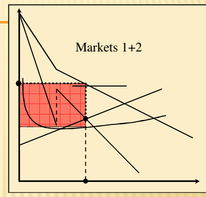
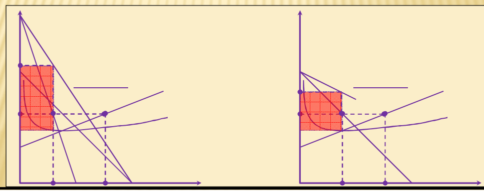
COMPARE PRICES AND PROFITS

- Separated markets 1, 2
- Combined markets 1+2
- Higher profits if you can separate…





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OVERVIEW…

Monopolistic competition

- Monopoly
  - Simple model
  - Exploitation
  - Discriminating monopolist
  - Product diversity

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MARKET POWER AND PRODUCT DIVERSITY

- Nature of product is a major issue in classic monopoly
  - No close substitutes?
  - Otherwise erode monopoly position
- Now suppose *potentially* many firms making substitutes
  - Firms' products differ one from another
  - Each firm is a local monopoly – downward-sloping demand curve
  - New firms can enter with new products
  - Diversity may depend on size of market
  - Like corner shops dotted around the neighbourhood
- Use standard analysis
  - Start with a single firm – use monopoly paradigm
  - Then consider entry of others, attracted by profit…
  - …process similar to competitive industry

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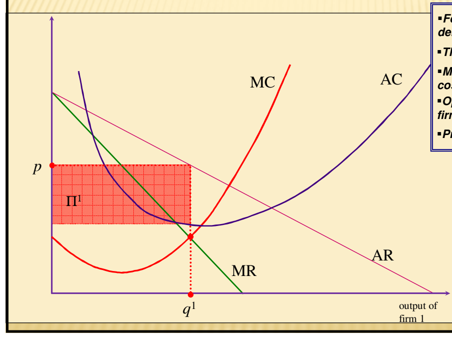
MONOPOLISTIC COMPETITION: 1 FIRM



- *For simplicity take linear demand curve (AR)*
- *The derived MR curve*
- *Marginal and average costs*
- *Optimal output for single firm*
- *Price and profits*

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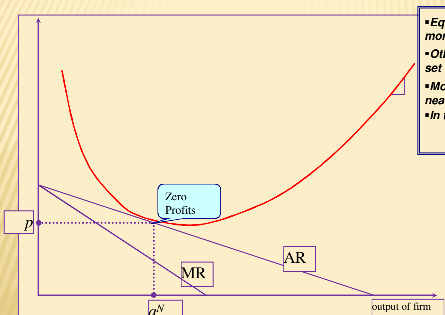
MONOPOLISTIC COMPETITION: ENTRY



- *Equilibrium with one local monopoly*
- *Other local monopolies set up nearby*
- *More local monopolies nearby*
- *In the limit*

- *Number of local monopolies, N determined by zero-profit condition*

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WHAT NEXT?

- All variants reviewed here have a common element…
- Firm does not have to condition its behaviour on what other firms do…
- Does not attempt to influence behaviour of other firms
  - Not even of potential entrants
- Need to introduce strategic interdependence

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