Unit 7:
The Firm, Demand Elasticity and Market Competition

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Introduction

Introduction

How do the firm and consumers interacts?

- We have been neglecting revenue for the past units. What's its deal?
- To answer this question, we need to see how consumers look like from firm's perspective
- Firm doesn't see consumer as individuals; what they see is **demand**
  - How sensitive the demand is to the prices? (price elasticity)
  - Can I produce enough to satisfy all demand? (returns to scale)
  - Can I alter the demand / set prices? (market power)
  - How I benefit from production and trade? (producer/consumer surplus)

Elasticity & Price Elasticity of Demand

Elasticity in general

Definition (The x-elasticity of y)

The x-elasticity of y measures the fractional response of y to a fraction change in x

- Elasticity is the measure of the **sensitivity** of one variable to another.
- A **highly elastic** variable will **respond more dramatically** to changes in the variable it is dependent on
- The formula for elasticity is

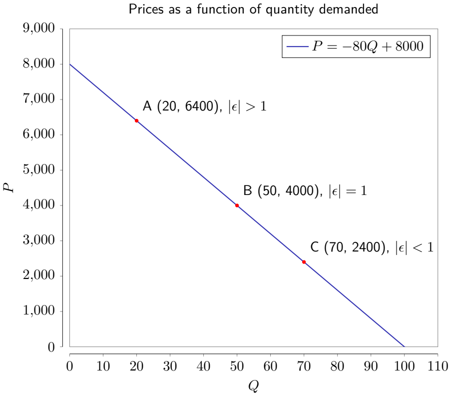
$$\frac{\text{growth rate of } y}{\text{growth rate of } x} \quad \text{or} \quad \begin{aligned} \frac{(y_2 - y_1)/y_1}{(x_2 - x_1)/x_1} \quad & \text{if discrete,} \\ \frac{\partial y/y}{\partial x/x} \quad & \text{if continuous.} \end{aligned}$$

Price Elasticity of Demand

Following the definition of elasticity, the specification on how sensitive quantity demanded (y) is to the price (x) is $\epsilon = \dfrac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1}$

Assume change in price is 1,

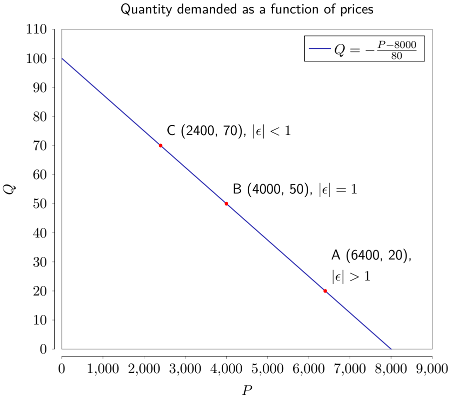
- $|\epsilon_A| = \left|\frac{(20-20.0125)/20}{(6400-6399)/6400}\right| = 4$
  - $6399 = -80 \times 20.0125 + 8000$
- $|\epsilon_B| = \left|\frac{(50-50.0125)/20}{(4000-3999)/4000}\right| = 1$
  - $3999 = -80 \times 50.0125 + 8000$
- $|\epsilon_C| = \left|\frac{(70-70.0125)/20}{(2400-2399)/6400}\right| = 0.43$
  - $2399 = -80 \times 70.0125 + 8000$



Elasticity and Slope: History Story

Is price determining quantity demanded, or the other way around?

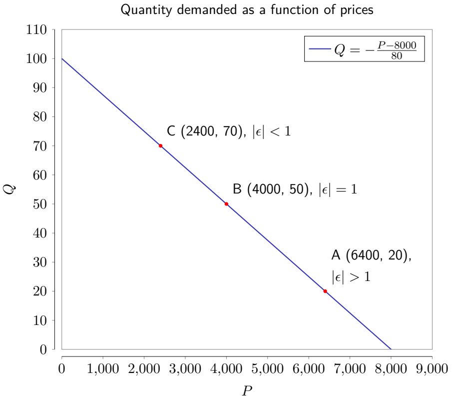
- Mathematically speaking, above question is asking $Q(P)$ or $P(Q)$
- Graphically speaking, QP plane is saying $P(Q)$, i.e., *quantity demanded determines prices* ... match experience?
- What is the "slope" in the axis-swapped figure? Roughly elasticity?



Elasticity and Slope: History Story

Is price determining quantity demanded, or the other way around?

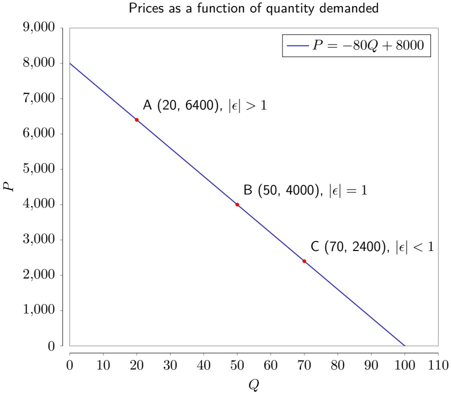
- Slope are $-\frac{1}{80}$, the inverse of the slope before, and constant over A, B, and C.
- Turns out the original formulation is this figure, i.e., price determines the quantity demanded, and we can measure the **absolute change** of demand using slope.



Elasticity and Slope: History Story

Is price determining quantity demanded, or the other way around?

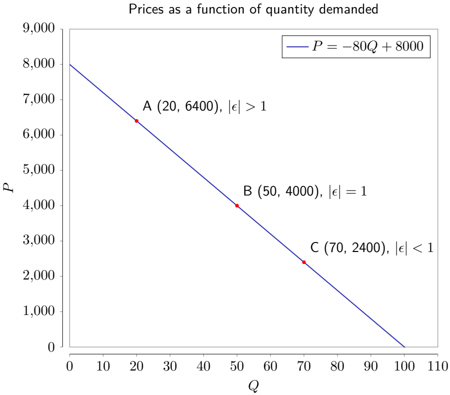
- However, some Economists wants to compare growth in quantity demanded when prices are in a certain region over a long time series, which motivates them to swap the axis.
- But they still want to see how quantity changes with the price!



Elasticity and Slope: History Story

Is price determining quantity demanded, or the other way around?

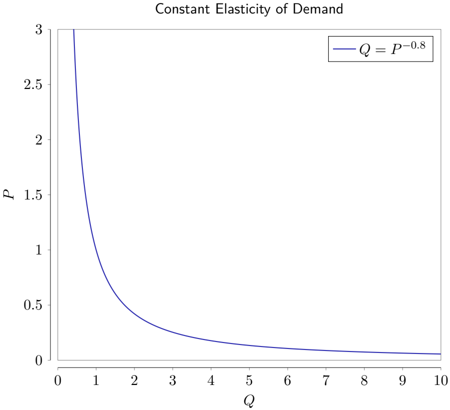
- Eventually, as time goes by, we separate the definition as:
- Slope measures the **absolute/average changes**
- Elasticity measure the **relative/percentage/marginal changes**
- Thus, a straight line has constant slope but different elasticity



Constant Elasticity of Demand

Since a straight line doesn't provide constant elasticity, what's the shape of demand function has constant elasticity?

- Recall $\epsilon = \frac{P}{Q(P)} \frac{\partial Q(P)}{\partial P}$, and $Q(P)$ is a function of P.
- $Q(P)$ needs to have some power so that after differentiation, all the P's cancels out and left only constant.
- If $Q(P) = P^{-0.8}$, then $\epsilon = \frac{P}{P^{-0.8}} \frac{\partial (P^{-0.8})}{\partial P} = \frac{P}{P^{-0.8}} \times (-0.8) P^{-1.8} = -0.8$



Production: Key Concept

Economies of Scale / Return to Scale

- **Return to scale**: how output will change when inputs increase
- **Constant return to scale** (CRS): $xzF(K, N^d) = zF(xK, xN^d)$
  - output increase proportionally with inputs
  - small firms are as efficient as large firms
- **Increasing return to scale** (IRS): $xzF(K, N^d) > zF(xK, xN^d)$
  - output increase more than proportionally with inputs
  - small firms are less efficient than large firms
- **Decreasing return to scale** (DRS): $xzF(K, N^d) < zF(xK, xN^d)$
  - output increase less than proportionally with inputs
  - small firms are more efficient than large firms

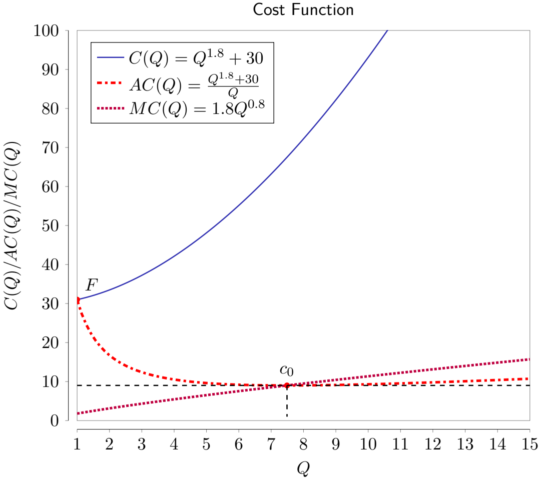
Economies of Scale: Example

- IRS $\rightarrow$ Economies of scale, and DRS $\rightarrow$ Diseconomies of scale
- Economies of scale includes:
  1. Cost advantages – Large firms can purchase inputs on more favourable terms, because they have greater bargaining power when negotiating with suppliers.
  2. Demand advantages - Network effects (value of output rises with number of users e.g. software application)
- However, large firms can also suffer from diseconomies of scale
  - e.g. additional layers of bureaucracy due to too many employees.

Cost Function

Cost functions show how production costs vary with quantity produced.

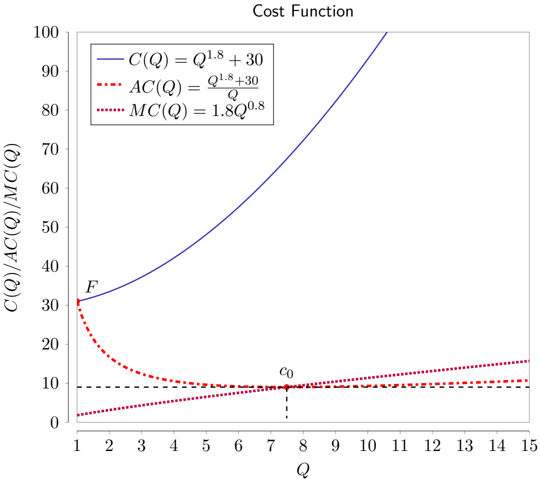
- $AC(Q) \equiv \frac{C(Q)}{Q}$: average cost
- $MC(Q) \equiv \frac{\partial C(Q)}{\partial Q}$: marginal cost
- F: fixed cost
- c_0: lowest point on $AC(Q)$
- Why $AC(Q)$ and $MC(Q)$ intersect at the lowest point?



Cost Function

Cost functions show how production costs vary with quantity produced.

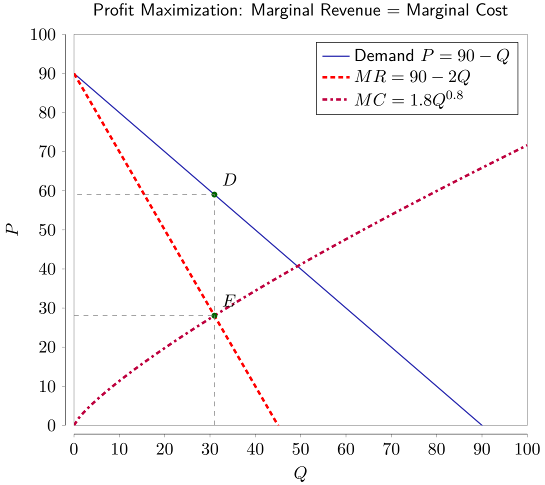
- c_0: lowest point on $AC(Q)$
- $MC(Q)$ always increase as Q increases
- If $AC(Q) > (<) MC(Q)$: the relative increment in cost function, i.e., marginal cost, is **smaller** **(larger)** than the increment of 1 unit Q (denominator), and thus $AC(Q) \downarrow (\uparrow)$



Profit Maximization

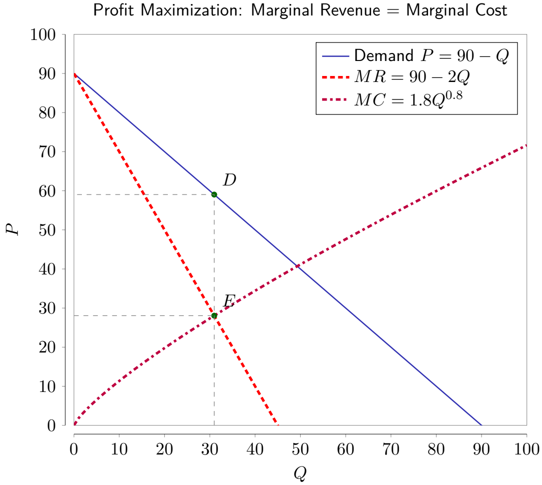
If Price is a Function of Quantity

- Assume the firm is monopoly: price being affected by quantity decision
- Profit max: $\pi = R(Q) - C(Q)$
- $\frac{\partial R(Q)}{\partial Q} \Rightarrow MR(Q)$
- $\frac{\partial C(Q)}{\partial Q} \Rightarrow MC(Q)$



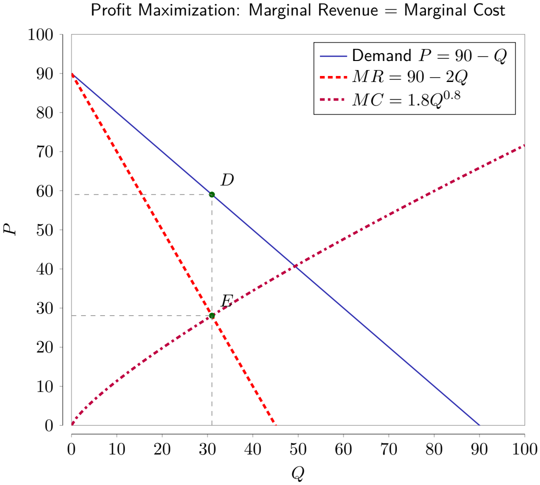
If Price is a Function of Quantity

- FOC: $MR - MC = 0 \Rightarrow MR = MC$
- Intersect at E, which determines optimal $Q = 30.97$
- As firm produce at $Q = 30.97$, the market price $P = 90 - 30.97 = 59.03$.



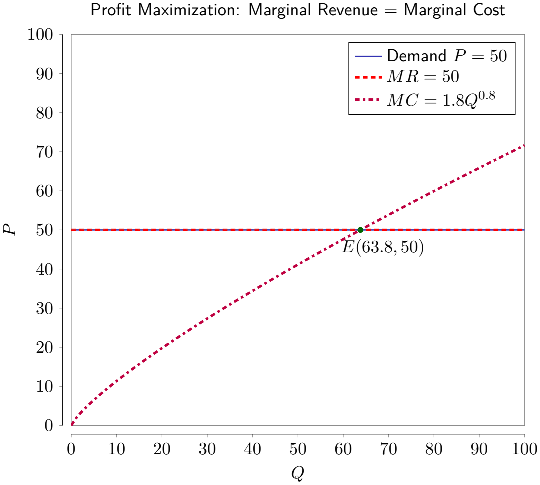
If Price is a Function of Quantity

- Another way to maximize profit is by isoprofit curve and demand itself.
- MC is also the individual supply curve



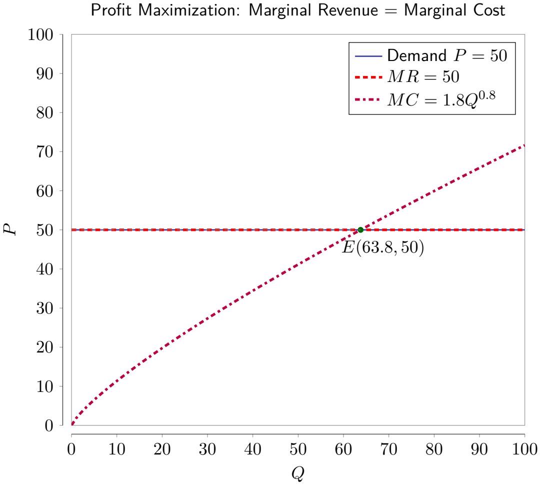
If Price is NOT a Function of Quantity (Residual Demand)

- Assume the firm is in perfect competition: infinite number of firms and each taken prices as given (no market power)
- This tiny firm thinks it is facing a horizontal demand curve, which means that he cannot affect prices with quantity produced



If Price is NOT a Function of Quantity (Residual Demand)

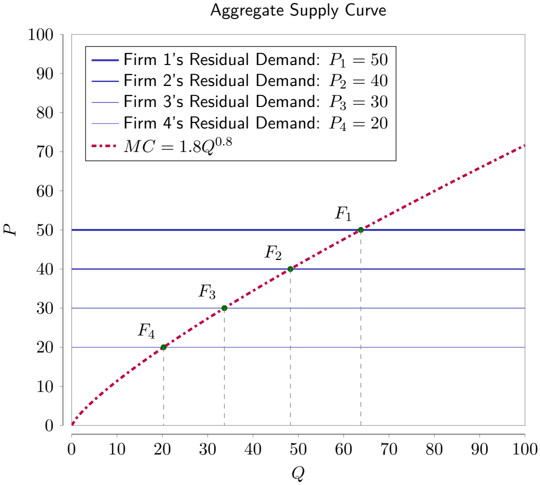
- The demand that **firm is perceiving** is called residual demand
- $P = 50 \Rightarrow R(Q) = 50Q \Rightarrow MR = 50$
- $P = MR = MC \Rightarrow 1.8Q^{0.8} = 50 \Rightarrow Q = (\frac{50}{1.8})^{\frac{1}{0.8}} \approx 63.77$



Gains from Trade

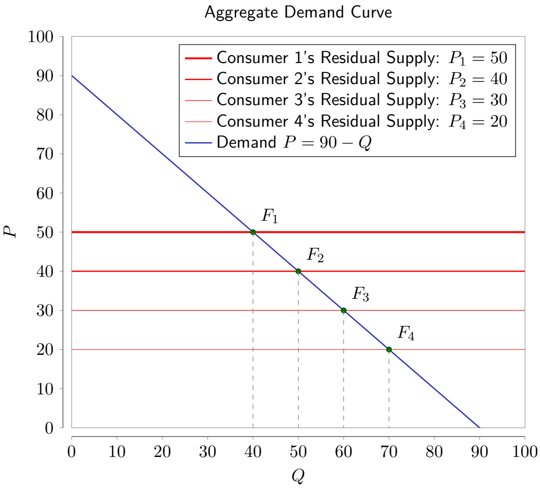
Individual Supply Aggregates into Aggregate Supply

- Tiny firm 1 is facing residual demand $P_1 = 50$, and thus he wants to produce at $Q \approx 63.77$
- Tiny firm 2: $P_2 = 40$, produce $Q = (\frac{40}{1.8})^{\frac{1}{0.8}} \approx 48.25$
- Same applies to firm 3 and 4, and thus even all firms have the same cost function, each point at supply curve represent each firm.



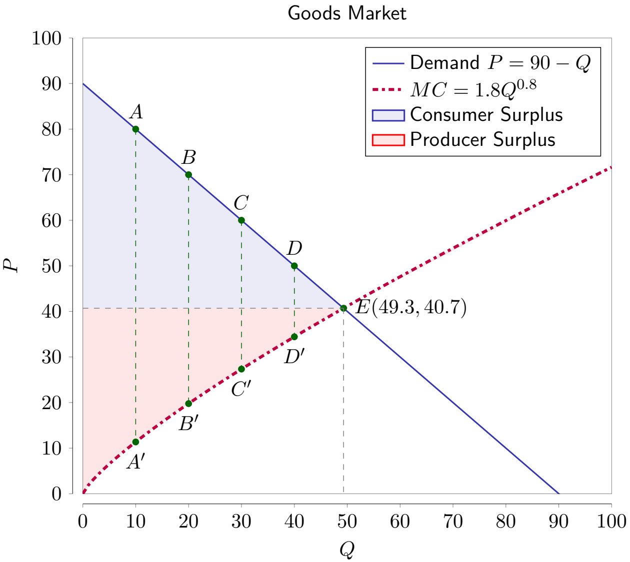
Individual Demand Aggregates into Aggregate Demand

- Tiny consumer 1 is facing residual supply $P_1 = 40$, and thus he wants to buy at $Q = 40$
- Tiny consumer 2: $P_2 = 50$, buy at $Q = 50$
- Same applies to consumer 3 and 4, and thus even all consumers have the same demand function, each point at demand curve represent each consumer.



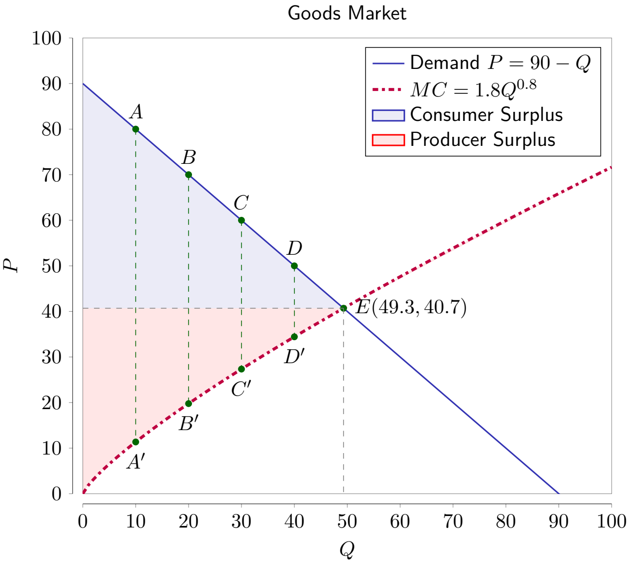
Consumer and Producer Surplus

- Consumer A is willing to pay $P_A = 80$
- Firm A' is will to produce at cost $P_{A'} = 1.8 \times 10^{0.8} \approx 11.36$
- Both pay $P^* = 40.7$:



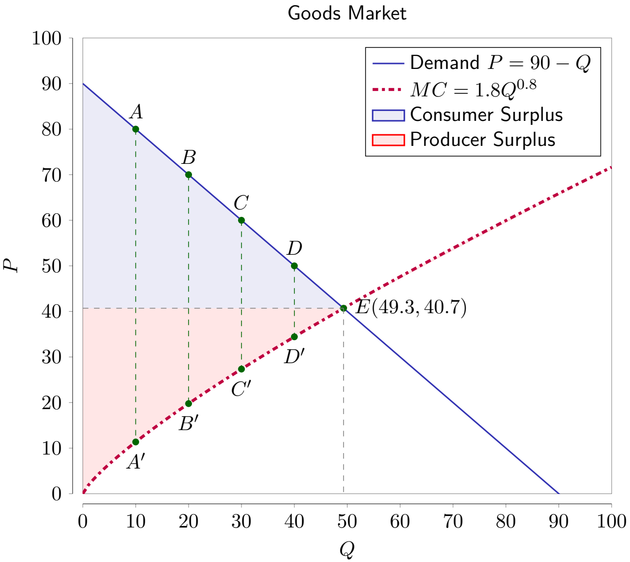
Consumer and Producer Surplus

- Consumer B is willing to pay $P_B = 70$
- Firm B' is will to produce at cost $P_{B'} = 1.8 \times 20^{0.8} \approx 19.77$
- Both pay $P^* = 40.7$:



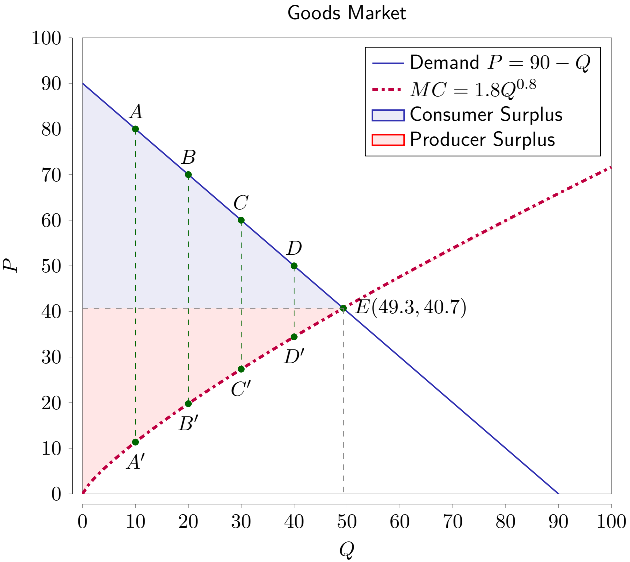
Consumer and Producer Surplus

- Consumer C is willing to pay $P_C = 60$
- Firm C' is will to produce at cost $P_{C'} = 1.8 \times 30^{0.8} \approx 27.35$
- Both pay $P^* = 40.7$:



Consumer and Producer Surplus

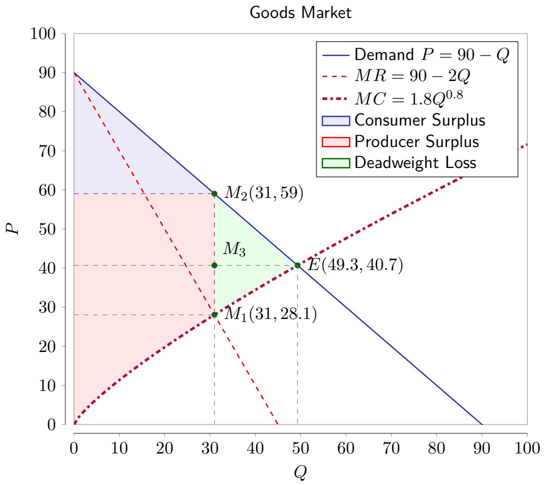
- Consumer D is willing to pay $P_D = 50$
- Firm D' is will to produce at cost $P_{D'} = 1.8 \times 40^{0.8} \approx 34.43$
- Both pay $P^* = 40.7$:



Market Power

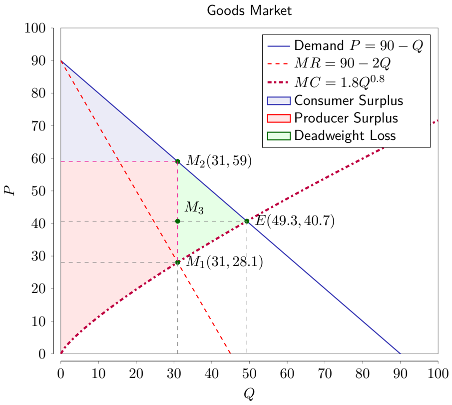
What if firm is monopoly?

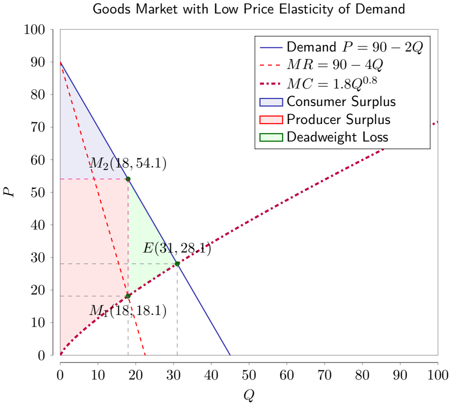
- $MR = MC$ determines $Q^* = 31$, and vertical upward to Demand at M_2 to get $P^* = 59$.
- Deadweight Loss created: $\triangle EM_1M_2$
- CS $\downarrow \because$ DWL & PS
- PS $\uparrow$: gave up $\triangle EM_1M_3$, but gain part of CS



Markup / Price Spread

- Markup $= \frac{P - MC}{P}$ is a measure of market power
- Graphically represented by $\overline{M_1 M_2}$, is inversely proportional to price elasticity of demand.





Price Elasticity and Market Power I

- A firm's profit margin depends on the elasticity of demand, which is determined by competition:
    - Demand is relatively **inelastic** if there are **few close substitutes**
    - Firms with market power have enough bargaining power to set prices without losing customers to competitors
- Competition policy (limits on market power) can be beneficial to consumers when firms collude to keep prices high.

Price Elasticity and Market Power II

- Example of market power: A firm selling specialized products.
  - They face little competition and hence have inelastic demand.
  - They can set price above marginal cost without losing customers, thus earning **monopoly rents**.
  - This is a form of market failure because there is deadweight loss.
- A natural monopoly arises when one firm can produce at lower average costs (+) than two or more firms e.g. utilities.
- Instead of encouraging competition, policymakers may put price controls or make these firms publicly owned.

Price Elasticity and Market Power III

- Firms can increase their market power by:
  1. Innovating – Technological innovation can allow firms to differentiate their products from competitors' e.g. hybrid cars.
     - Firms that invent a completely new product may prevent competition altogether through patents or copyright laws.
  2. Advertising – Firms can attract consumers away from competing products and create brand loyalty. Advertising can be more effective than discounts in increasing demand for a brand.
- Both of these tactics can shift the firm's demand curve.