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1.2.2) Comparative Static analysis in Math framework

Having solved for the equilibrium solution, what economists usually ask is what would happen to the equilibrium if something, previously assumed to be fixed, has changed.

Example 1.C (cont.): National income model

- From the example 1.B, it is straightforward to solve for all the endogenous equilibrium solutions, Y^*, C^*, Y_d^*.

$y = AE$

$y = C + I + G$

$y = a + by_d + I + G$

$y = a + b(y - T) + I + G$

$y = a + by - bT + I + G$

$y - by = a + bT + I + G$

$y(1-b)$

$y = \frac{a + bT + I + G}{1 - b}$

- Numerically, if a = 1, T_0 = \$0 I_0 = \$1, G_0 = \$1 and b = 0.5, this yields us,

$y = 1 - a3(0) + 1 + 1$

$= \frac{3}{0.3}$

$y^* = 6$

$y_d^* = y^* - T_0$

$= 6 - 0$

$= 6$

$C^* = a + by_d +$

$= 1 + 0.5(6)$

$= 4$

More about the elasticity of demand

- Own-price elasticity of demand is always less than or equal to zero! (why?)
  - Negative sign only implies that negative relationship between price and quantity demand.
  - Absolute number of the figure tells us about the degree of sensitivity of quantity demanded to the price change.

- Conventionally, we classify the case for elasticity of demand into three cases.

$$\left|\frac{\%\Delta Q}{\%\Delta P}\right| : \begin{array}{lll} > 1 & ; & elastic \\ = 1 & ; & unit\ elastic \\ < 1 & ; & inelastic \end{array}$$

- Two important implications of elasticity for practical use.
  - Boosting revenue; when to raise the price!
  - Optimal commodity taxation; DW loss proportional to elasticity

Example 2.G: Elasticity of linear demand curve and some important properties

Suppose that $p = 10 - Q$, derive the formula for the elasticity of demand

1.

$p = a - bQ$

$Q = \frac{a - p}{b}$

$PED = \frac{\Delta Q}{\Delta P} \times \frac{P_0}{Q_0}$

$= \frac{-1}{b} \times \frac{P_0}{\frac{a - P_0}{b}}$

$p = a - cQ$

$Q = \frac{a - P}{c}$

$PED = \frac{\Delta Q}{\Delta P} \times \frac{P_0}{Q_0}$

$= \frac{-1}{c} \times \frac{P_0}{\frac{a - P_0}{c}}$

2.

$\frac{\Delta Q}{\Delta P} \times \frac{P_0}{Q_0}$

$\frac{1}{d}\left(\frac{P_0}{\frac{P_0 - C}{d}}\right)$

slope $= p = c + dQ$

$-dQ = c - P$

$Q = \frac{P - C}{d}$

slope $= \frac{1}{d}$

Example 2.I: A monopolist firm faces the market demand given by $P = 10 - Q$. Consider the following questions if the cost function $C(Q) = 4Q$.

- What is the revenue-maximizing level of output?

Revenue function

$TR(Q) = P(Q) \times Q$

$= 10 - Q \times Q$

$= 10Q - Q^2$

$\frac{dTR}{dQ} = 10 - 2Q$

$10 - 2Q = 0$

$Q = 5$

* Maximum occurs when $\frac{dTR}{dQ} = 0$

at $Q = 5$, TR is max

$= 10(5) - 5^2$

$= 50 - 25$

$TR = 25$

- What is the break-even output?

$TR = TC$

$10Q - Q^2 = 4Q$

$6Q = Q^2$

$6 = Q$

- What is the profit-maximizing level of output?

1. $MR = MC$

$10 - 2Q = 4$

$6 = 2Q$

$Q = 3$

2. $\pi = TR - TC$

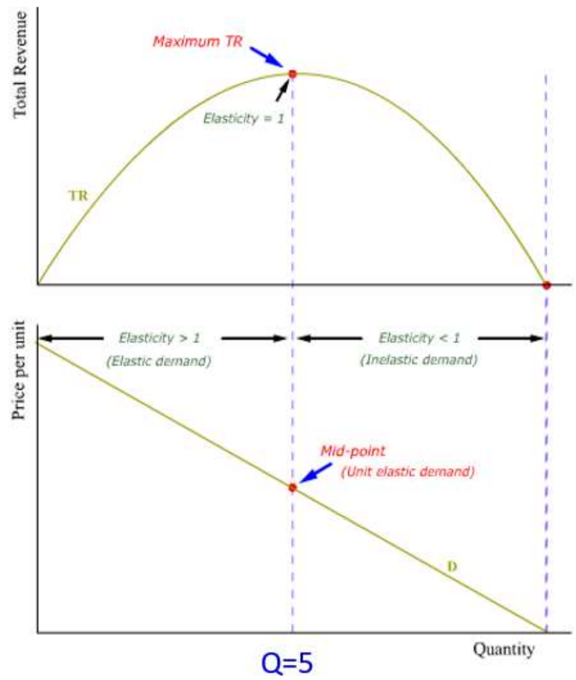
$= 10Q - Q^2 - 4Q$

$\frac{d\pi}{dQ} = 6Q - Q^2$

$= 6 - 2Q$

$Q = 3$

Quadratic function: revenue function/break even analysis



$$\left|\frac{\%\Delta Q}{\%\Delta P}\right| : \begin{array}{lll} >1 & ; & elastic \\ =1 & ; & unit\ elastic \\ <1 & ; & inelastic \end{array}$$

Revenue maximizing output:
unit elasticity

Profit-maximizing output:
under region with **elastic** demand

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Exrcise 2B. Consider a function that relates tax revenues R, in billions of dollars, to the average tax rate t such that $R = 350t - 500t^2$.

(a) What tax rate(s) is consistent with raising tax revenues equal to \$60 billion?

(b) What tax rate(s) is consistent with raising tax revenues equal to \$61.25 billion?

(c) What tax rate is consistent with the maximum tax revenue?

a. $60 = 350t - 500t^2$

$500t^2 - 350t^2 + 60 = 0$

$t = \pm \frac{2}{5}$

$= 40\%$

b. $61.25 = 350t - 500t^2$

$500t^2 - 350t + 61.25 = 0$

$t = \pm \frac{7}{20}$

$= 35\%$

c. $\frac{dR}{dT} = 350t - 200t^2$

$= 350 - 1000t$

$0 = 350 - 1000t$

$t = \frac{7}{20}$

$= 35\%$