Group Assignment 1

Answer

2\. a. Since there is no second product or other products to compare with, we cannot determine whether product x is substitute product or complementary product

b\. Derive the market demand equation.

Given demand equation for consumer J : $P = 10 + k_1P_x + k_2Y - Q_j^d \Rightarrow Q_j^d = 10 + k_1P_x + k_2Y - P$

Since 10 consumers in the market are identical, market demand equation is

$$Q^d = 10(10 + k_1P_x + K_2Y - P) \Rightarrow Q^d = \begin{cases} 0 & ; P \geq 10 + k_1P_x + K_2Y \\ 10(10 + k_1P_x + K_2Y - P) & ; P < 10 + k_1P_x + K_2Y \end{cases} \quad \#$$

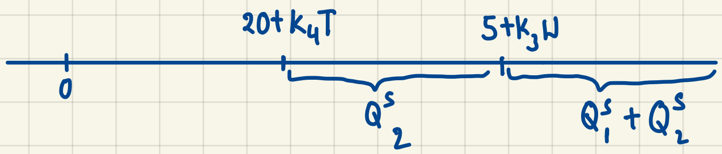
c\. Condition: (i) $0 < (20 + k_4T) < (5 + k_3W)$ & (ii) $10 + k_1P_x + k_2Y > 5 + k_3W$

In term of relative cost advantage, the first condition tells that firm that depends on technology has lower opportunity cost, comparing to firm that relies on gasoline. $(0 < 20 + K_4T < 5 + k_3W)$

. Derive market supply equation

$$\text{Firm}_1 : P = 5 + K_3W + Q_1^s \Rightarrow Q_1^s = P - 5 - K_3W \begin{cases} Q_1^s = 0 & ; P \leq 5 + k_3W \\ Q_1^s > 0 & ; P > 5 + k_3W \end{cases}$$

$$\text{Firm}_2 : P = 20 + K_4T + 2Q_2^s \Rightarrow Q_2^s = \frac{P - 20 - K_4T}{2} \begin{cases} Q_2^s = 0; P \leq 20 + k_4T \\ Q_2^s > 0; P > 20 + K_4T \end{cases}$$



$$\Rightarrow Q^s = \begin{cases} 0 & ; P \geq 20 + k_4T \\ \dfrac{P - 20 - k_4T}{2} & ; 20 + k_4T < P \leq 5 + k_3W \\ P - 5 - k_3W + \dfrac{P - 20 - k_4T}{2} & ; P > 5 + k_3W \end{cases}$$

$$\Rightarrow Q_s = \begin{cases} 0 & ; P \geq 20 + k_4T \\ \dfrac{P - 20 - k_4T}{2} & ; 20 + k_4T < P < 5 + k_3W \\ \dfrac{3P}{2} - 15 - k_3W - \dfrac{k_4T}{2} & ; P > 5 + k_3W \end{cases} \quad \#$$

d. The condition under which both firms will be active in market is when

$P > 5 + K_3 W$

e Solve for equilibrium price and quantity

$$\cdot Q^d = \begin{cases} 0 & ; P \geq 10 + 2(10) + 2(5) \\ 10(10 + 2(10) + 2(5) - P) & ; P < 10 + 2(10) + 2(5) \end{cases} \Rightarrow Q_d = \begin{cases} 0 & ; P \geq 40 \\ 10(40 - P) & ; P < 40 \end{cases}$$

$$\cdot Q_s = \begin{cases} 0 & ; P \geq 20 + 1(5) \\ \frac{P - 20 - 5}{2} & ; 20 + 1(5) < P < 5 + 3(10) \\ \frac{3P}{2} - 15 - 3(10) - \frac{1(5)}{2} & ; P > 5 + 3(10) \end{cases} \Rightarrow Q_s = \begin{cases} 0 ; & P \geq 25 \\ \frac{P-25}{2} ; & 25 < P \leq 35 \\ \frac{3P}{2} - \frac{95}{2} & ; P > 35 \end{cases}$$

Equilibrium : $Q^d = Q^s$

$$10(40 - P) = \frac{3P - 95}{2}$$

$$20(40 - P) = 3P - 95$$

$$-20P - 3P = -95 - 800$$

$$23P = 895$$

$$P^* = \frac{895}{23} \quad \#$$

$$Q^* = Q_d = 10(40 - P)$$

$$= 10\left(40 - \frac{895}{23}\right) = \frac{9200 - 8950}{23} = \frac{250}{23} \quad \#$$

f. Calculate the benefit of consumers and the two producers after subsidy

$$P^d = P^s - \$5$$

$$P_j^d = 10 + K_1 P_x + K_2 Y - Q_j^d = 40 - Q_j^d$$

$$P_1^s = 5 + K_3 W + Q_1^s = 35 + Q_1^s$$

$$P_2^s = 20 + K_4 T + 2Q_2^s = 25 + 2Q_2^s$$

. If $P^s = P_1^s$

$$\Rightarrow P^d = 35 + Q_1^s - 5 = 30 + Q_1^s$$

$$P^d = P_j^d \Leftrightarrow 30 + Q_1^s = 40 - Q_j^d$$

Equilibrium: $Q^s = Q^d$

$$\Rightarrow \quad 30 + Q = 40 - Q \Rightarrow 2Q = 40 - 30 \Rightarrow Q^* = 5$$

$$\Rightarrow \quad P_j^{d*} = 40 - 5 = 35$$

$$35 = P_1^s - 5 \Rightarrow P_1^{s*} = 40$$

Benefit of consumers = (Price before - Price after) x Q^* after

$$= \left(\frac{895}{23} - 35\right) \times 5 = \frac{450}{23} \quad \#$$

Benefits of producer 1 = (Price after - Price before) x Q^* after

$$= \left(40 - \frac{895}{23}\right) \times 5 = 125 \quad \#$$

<u>If $P^s = P_2^s$</u>

$$P^d = 25 + 2Q_2^s - 5 = 20 + 2Q_2^s$$

$$P^d = P_j^d \Leftrightarrow 20 + 2Q_2^s = 40 - Q_j^d$$

Equilibrium : $Q^s = Q^d$

$$20 + 2Q = 40 - Q$$

$$3Q = 40 - 20$$

$$Q^* = \frac{20}{3}$$

$$\Rightarrow P^{d*} = 40 - \frac{20}{3} \; ; \quad P^{s*} = 40 - \frac{20}{3} + 5 = 45 - \frac{20}{3}$$

$\Rightarrow$ Benefits of consumers $= \left[\frac{895}{23} - \left(40 - \frac{20}{3}\right)\right] \times \frac{20}{3} = \frac{8855}{207}$ #

$\Rightarrow$ Benefits of produce 2 $= \left[45 - \frac{20}{3} - \frac{895}{23}\right] \times \frac{20}{3} = \frac{-800}{207}$ #

1\. a. Endogenous variables are P_x^d ; Q_x^d ; P_x^s ; Q_x^s

Exogenous variable is P_y

b. $P_x = 8 - bQ_x^d + CP_y \Rightarrow Q_x^d = \dfrac{8 + CP_y - P_x}{b}$

$P_x = 20 + dQ_x^s \Rightarrow Q_x^s = \dfrac{P_x - 20}{d}$

Equilibrium: $Q_x^s = Q_x^d$

$$\frac{P_x - 20}{d} = \frac{8 + CP_y - P_x}{b}$$

$$8 + CP_y - P_x = \frac{P_x \cdot b - 20b}{d}$$

$$CP_y = \frac{P_x b - 20b}{d} + P_x - 8$$

$$P_y = \frac{P_x b - 20b}{cd} + \frac{P_x - 8}{c}$$

c. Solve for equilibrium P_x^* and Q_x^*

Equilibrium $Q_x^* = Q_x^s = Q_x^d$

$$\frac{P_x - 20}{d} = \frac{8 + CP_y - P_x}{b}$$

$$P_x = \left(\frac{8 + CP_y - P_x}{b}\right) d + 20$$

$$P_x + \frac{P_x \cdot d}{b} = 8\frac{d}{b} + \frac{cd}{b} P_y + 20$$

$$P_x b + P_x d = 8d + cdP_y + 20b$$

$$P_x^* = \frac{8d + cdP_y + 20b}{b+d} \quad \#$$

$$\Rightarrow Q_x^* = \frac{\dfrac{8d + cdP_y + 20b}{b+d} - 20}{d} = \frac{8d + cdP_y + 20b - 20b - 20d}{(b+d)d} = \frac{-12d + cdP_y}{(b+d)d}$$

$$= \frac{cP_y - 12}{b+d} \quad \#$$

d. Calculate the magnitude of the response of equilibrium quantity to change in exogenous variable.

$$\frac{\Delta Q^*}{\Delta P_y} = \frac{c}{b+d}$$

4. a. Find the equilibrium before tax:

$$P^d = 14 - 3Q^d \Rightarrow Q^d = \frac{14 - P^d}{3}$$

$$P^s = 4 + 2Q^s \Rightarrow Q^s = \frac{P^s - 4}{2}$$

Equilibrium: $Q^* = Q^s = Q^d$

$$\frac{P - 4}{2} = \frac{14 - P}{3}$$

$$3P - 12 = 28 - 2P$$

$$5P = 40 \Rightarrow P^* = 8 \quad \#$$

b. The condition that links between consumer's and producer's price

$$P^d = P^s + t$$

c. Find the equilibrium after tax

$$P^d = 14 - 3Q$$

$$P^s = 4 + 2Q$$

$$P^d = P^s + t$$

$$= 4 + 2Q + t$$

$$\Rightarrow 4 + 2Q + t = 14 - 3Q$$

$$5Q = 14 - 4 - t$$

$$Q^* = \frac{10 - t}{5} \quad \#$$

$$\Rightarrow P_d^* = 14 - 3\left(\frac{10 - t}{5}\right) = 14 - 6 + \frac{3t}{5} = 8 + \frac{3t}{5} \quad \#$$

$$\Rightarrow P^d = P^s + t \Rightarrow P^s = P^d - t$$

$$= 8 + \frac{3t}{5} - t = 8 - \frac{2t}{5}$$

d. Calculate consumer's and producer's burden

- consumer's burden = (Price after − Price before) × Q^* after

$$= \left(8 + \frac{3t}{5} - 8\right) \times \frac{10 - t}{5} = \frac{30t - 3t^2}{25} \quad \#$$

- producer's burden = (Price before − Price after) × Q^* after

$$= \left[8 - \left(8 - \frac{2t}{5}\right)\right] \times \frac{10 - t}{5} = \frac{20t - 2t^2}{25} \quad \#$$

Therefore, consumer bears more burden than producer.

e. The revenue the government can collect from market equilibrium

$$\text{Rev.} = t \times Q^* \text{ after}$$

$$= t \times \frac{10-t}{5} = \frac{10t - t^2}{5} \quad \#$$

f. Find the t level that maximize revenue

t that maximize revenue is $t^* = \frac{-b}{2a} = \frac{-10}{2(-1)} = \$5$ #

3. a. Write the system of linear equations in matrix form

. linear equation: ①. $Y = C + I + G$

$$= 0.3(Y - T_0) - K_1 r + 0.5Y - K_2 r + G_0$$

$$Y = 0.8Y - 0.3T_0 - (K_1 + K_2) r + G_0$$

$$\Rightarrow 0.2Y = G_0 - 0.3T_0 - (K_1 + K_2) r$$

$$\Rightarrow 0.2Y + (K_1 + K_2) r = G_0 - 0.3T_0$$

②. $M^s = M^d$

$M_0 = K_3 Y - K_4 r$ or $K_3 Y - K_4 r = M_0$

System of equation : $\begin{cases} 0.2Y + (K_1 + K_2) r = G_0 - 0.3T_0 \\ K_3 Y - K_4 r = M_0 \end{cases}$

Matrix form : $\begin{bmatrix} 0.2 & K_1 + K_2 \\ K_3 & -K_4 \end{bmatrix} \begin{bmatrix} Y \\ r \end{bmatrix} = \begin{bmatrix} G_0 - 0.3T_0 \\ M_0 \end{bmatrix}$ #

b. Solve for equilibrium (Y^*, r^*)

$$\begin{bmatrix} 0.2 & K_1 + K_2 \\ K_3 & -K_4 \end{bmatrix} \begin{bmatrix} Y \\ r \end{bmatrix} = \begin{bmatrix} G_0 - 0.3T_0 \\ M_0 \end{bmatrix}$$

$$A \quad x \quad = \quad d$$

$$|A| = -0.2 \cdot K_4 - K_3(K_1 + K_2) = -0.2K_4 - K_1K_3 - K_2K_3$$

$$|A_Y| = \begin{vmatrix} G_0 - 0.3T_0 & K_1 + K_2 \\ M_0 & -K_4 \end{vmatrix} = -G_0 K_4 + 0.3T_0 K_4 - (K_1 + K_2) M_0$$

$$Y^* = \frac{|A_Y|}{|A|} = \frac{-G_0 K_4 + 0.3T_0 K_4 - (K_1 + K_2) M_0}{-0.2K_4 - K_1K_3 - K_2K_3} \quad \#$$

$$r^* = \frac{|A_r|}{|A|}$$

$$|A_r| = \begin{bmatrix} 0.2 & G_0 - 0.3T_0 \\ k_3 & M_0 \end{bmatrix} = 0.2M_0 - k_3(G_0 - 0.3T_0) = 0.2M_0 - k_3 G_0 + 0.3T_0$$

$$\Rightarrow \quad r^* = \frac{0.2M_0 - k_3 G_0 + 0.3T_0}{-0.2k_4 - k_1k_3 - k_2k_3} \quad \#$$

c.

$$y^* = \frac{-G_0 k_4 + 0.3T_0 k_4 - (k_1+k_2)M_0}{-0.2k_4 - k_1k_3 - k_2k_3} = \frac{G_0 k_4 - 0.3T_0 k_4 + (k_1+k_2)M_0}{0.2k_4 + k_3(k_1+k_2)}$$

$$\frac{\Delta y^*}{\Delta G_0} = \frac{k_4}{0.2k_4 + k_3(k_1+k_2)}$$

The fiscal policy, a change in goverment purchases, will become more effective if k_1 & k_2 are getting bigger this is because an increase in government purchases will encourage consumption and investment which makes aggregate expenditure rises and eventually output will increases too. However, with the increase of government spending will not alter interest rate, but the increase in output will do, so interest rate will increase which makes the output decrease a bit. This is the crowding out effect from the change in the govemment purchases. However, this effect will be quite weak due to the larger value of k_1 and k_2. Thus, the fiscal policy is effective because it can increase the output to be higher than the initial output.