Numerical Simulation

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Effects of an advertisement ban

Introduction

Motivation

- Nowadays, governments want people to motivate to stop smoking.
- They could consider introducing an advertisement ban.
- In this exercise we will see that an advertisement ban might not have the effect hoped for.

Exercise

Description

- Consider two firms that produce and sell cigarettes (differentiated products).
- The demand functions are:

$$q_1 = 500 - 15p_1 + 5p_2 + 5\sqrt{A_1} - 3\sqrt{A_2}$$
$$q_2 = 500 + 5p_1 - 15p_2 - 3\sqrt{A_1} + 5\sqrt{A_2}$$

- q_i denotes the quantity, p_i the price per unit and A_i the advertising expenditure of firm i, $i = 1, 2$.
- Marginal costs are constant and equal to 2 per unit for both firms.
- Consider a (one-shot pure) Nash equilibrium in which each firm sets its own price and advertising level, conditional on the price and advertising level of the competing firm.

Part a

- Denote the prices, advertising levels, quantities and profits in this equilibrium.
- The profit function of firm 1 is equal to:

$$\pi_1 = (p_1 - c)q_1 - A_1$$
$$\pi_1 = (p_1 - 2)(500 - 15p_1 + 5p_2 + 5\sqrt{A_1} - 3\sqrt{A_2}) - A_2$$

- First, let's solve for the equilibrium price level of firm 1.
- To do this, take the first order derivative with respect to p_1.

$$\frac{d\pi_1}{dp_1} = 500 - 15p_1 + 5p_2 + 5\sqrt{A_1} - 3\sqrt{A_2} + (p_1 - 2) * 15 = 0$$

- Solving for p_1 gives:

$$p_1 = 17\frac{2}{3} + \frac{1}{6}p_2 + \frac{1}{6}\sqrt{A_1} - \frac{1}{10}\sqrt{A_2}$$

- Similarly for firm 2 gives:

$$p_2 = 17\frac{2}{3} + \frac{1}{6}p_1 + \frac{1}{6}\sqrt{A_1} - \frac{1}{10}\sqrt{A_2}$$

- By substituting these best-response functions into each other, we can solve for the equilibrium price levels.
- Note, that the firms are symmetric! This implies that price levels and advertisement levels of both firms are equal.

$$p_1 = 17\frac{2}{3} + \frac{1}{6}p_1 + \frac{1}{6}\sqrt{A_1} - \frac{1}{10}\sqrt{A_2}$$
$$p_1 = p_2 = 21\frac{1}{5} + \frac{2}{25}\sqrt{A_1}$$

- Second, let's solve for the equilibrium advertisement level of firm 1.
- To do this, take the first order derivative with respect to A_1.

$$\frac{d\pi_1}{dA_1} = (p_1 - 2)(2\frac{1}{2}\frac{1}{\sqrt{A_1}}) - 1 = 0$$

- Solving for A_1 gives:

$$A_1 = A_2 = (2\frac{1}{2}p_1 - 5)^2$$

- Now we have 2 equations, with 2 unknowns. We can substitute the functions into each other, which will gives the solution of the equilibrium price and advertisement levels.
- The final solution is:

$$p_1^* = p_2^* = 26$$

$$A_1^* = A_2^* = 3600$$

$$q_1^* = q_2^* = 360$$

$$\pi_1^* = \pi_2^* = 5040$$

Part b

- Investigate the effects of a ban on cigarette advertising. Explain (in words) why an advertising ban can increase profits.
- Now firms can only determine their prices.
- To determine the new price level, take the first order derivative with respect to price.

$$\frac{d\pi_1}{dp_1} = 500 - 15p_1 + 5p_2 + (p_1 - 2) * -15 = 0$$

- Solving for p_1 gives:

$$p_1 = 17\frac{2}{3} + \frac{1}{6}p_2$$

- Similary for firm 2:

$$p_2 = 17\frac{2}{3} + \frac{1}{6}p_1$$

- Substituting these best-reponse functions into each other will give the equilibrium price levels.
- Note that firms are symmetric!

$$p_1 = 17\frac{2}{3} + \frac{1}{6}p_1$$

- Solving for p_1 gives:

$$p_1^* = p_2^* = 21.20$$

- Next solve for the equilibrium quantities and profits.

$$q_1^* = q_2^* = 288$$
$$\pi_1^* = \pi_2^* = 5530$$

Conclusion

- The results show that when firms are not any longer allowed to advertise they can actually achieve higher profits!
- On the one hand, the advertisement ban decreases demand and therefore profits.
- On the other hand, firms will decrease their prices which gives upward pressure on demand and profits.
- If the price decrease is high enough it will offset the downward pressure on profits and might even increase profits.