600541 APPLIED BUSINESS ECONOMICS, 2021–22 TUTORIAL 9

If you wish to discuss the tutorial questions please come to my office hours.

1. (*Cabral* 16.4) In 1984, the US Congress passed legislation that allowed generic-drug makers to receive fast marketing approval from the Food and Drug Administration. Since then the market share of generic-drug companies has increased considerably (in volume). Branded-drug companies have attempted different tactics to protect their market share. In some cases, large pharmaceutical firms have paid generic firms to keep off the market. Ivax Corp. and Novartis AG, for example, have agreed not to market a generic competitor to Abbott Laboratories' hypertension drug Hytrin. In exchange, Abbott pays quarterly fees totalling several million dollars.

   Relate this example to the discussion on the persistence of monopoly power (page 85 of the lecture notes).

2. A firm has created a new product. The (per-period) demand for this product is linear, the price is denoted by p, and the production cost is c per unit. Demand and cost are constant over time.

   (a) Use a diagram to answer the following questions (assume $c = 0$). Consider a single period. What is the ratio of deadweight loss $DWL(p)$ to profit $\pi(p)$ when p is

      (i) the monopoly price?
      (ii) half the monopoly price?
      (iii) one quarter the monopoly price?

   (b) What happens to the ratio of per-period deadweight loss to per-period profit as the price decreases?

   Let L denote the number of periods for which the firm holds the patent for its new product. A weaker patent corresponds to a lower p. After the patent expires the market is competitive (which implies zero profits and zero deadweight loss after the patent expires).

   (c) Given your answer to (b), explain why the incentive for innovation (i.e. the total profit $L \cdot \pi(p)$ over the lifetime of the patent) can be kept constant while reducing the total deadweight loss over the lifetime of the patent ($L \cdot DWL(p)$). What does this imply about the optimal length and strength of patent?

3. This problem is a concrete illustration of the case where there are negative externalities of R&D investment on rival firms. The assumptions of the model below are consistent with those outlined in section 4.4.2 of the lecture notes, where the reward from innovation is a fixed prize (a patent).

   Two firms are considering an investment in a patent race. If the innovation occurs, then the winning firm obtains a monopoly, with a profit of £90 million (gross of the investment). If the innovation occurs, then welfare (gross of the investment) is £135 million.[1]

   Each firm either invests an amount £25 million or does not. If a firm does not invest, or loses the patent race, then its profits (gross of the investment) are zero. The probabilities of a firm winning the patent race and of the innovation occurring at all are as follows:[2]

   - Neither firm invests: no innovation.
   - One firm invests: investing firm innovates with probability $\frac{2}{3}$.
   - Both firms invest: each firm wins patent with probability $\frac{4}{9}$, and innovation occurs with probability $\frac{8}{9}$.

   (a) Suppose the firms choose independently whether to invest or not. Fill in the rest of the following payoff matrix with the appropriate expected profits, and find the Nash equilibrium.

		Firm B: Invest	**Firm** B: Don't
Firm A	Invest		
	Don't	0, 35	

   (b) If the two firms entered into an R&D agreement, so that instead their goal is to maximize joint profit, what would be their choice of investment?

   (c) What effect does the R&D agreement have on welfare?

4. Now suppose that everything is the same as in question 3, except now there are spillovers. The innovation now benefits the firm that loses the patent race by £81 million and the welfare increases by the same amount, i.e. welfare if the innovation occurs is £216 million (gross of the investment).

   Repeat parts (a)-(c) of question 3. What are the differences between your answers to the two questions?

[1] The social value of the innovation is greater than the private value because the monopoly cannot appropriate all the consumer surplus.

[2] The probability of innovation occurring when both firms invest is $1 - \frac{1}{9} = \frac{8}{9}$ because $\frac{1}{3}\frac{1}{3} = \frac{1}{9}$ is the probability that neither firm innovates (there is a $\frac{1}{3}$ probability that A would not eventually innovate, and a $\frac{1}{3}$ probability that B would not eventually innovate). The probability of each firm winning the patent when both invest is $\frac{1}{2}\frac{8}{9} = \frac{4}{9}$ because there is a $\frac{8}{9}$ probability of innovation, and a $\frac{1}{2}$ probability that a firm innovates before the other firm.