Imperfect Information in Health Care Markets

Exercise Session 13 - Supplier induced demand

Exercise 33

Upcoding is the practice of fraudently charging for higher paying services than the ones provided. Discuss similarities and differences between upcoding and inducing demand.

Exc. 33

Similarities:
- Both have a similar incentive structure: They increase the income but have a cost that can be interpreted either as a moral cost or actual expected cost in case of detection.
- To make either of the two possible, the physician needs superior knowledge about what service is right or about the service billed / provided.
- Both induce higher costs for health insurances

Differences:
- patient overtreated in case of SID but not in upcoding
- If overtreatment implies a health risk, SID can reduce welfare (upcoding is just redistributing money)

Exercise 34

A clinic offers 2 services. Demand for service i is $M_i + s_i$ where $M_i > 0$ is the primary demand and s_i is the induced demand for service $i \in \{1, 2\}$. Let the objective of the clinic be $u(y, s_1, s_2) = -e^{-\eta y} - 0.5s_1^2 - 0.5s_2^2$ where $y = (M_1 + s_1)p_1 + (M_2 + s_2)p_2$ is revenue of the clinic as p_i are the profit margins for the two services and $\eta > 0$ is a parameter.

a) What is the optimal proportion of inducement levels, i.e. s_1/s_2, that the clinic will choose?

b) Will an increase in p_1 in- or decrease the optimal inducement levels s_1 and s_2?

c) In Germany, the physician price for providing a given service to a patient insured in the private arm of the health insurance system is 2.3 times the price of providing the same service to a patient administered in the public arm. What does the model predict in terms of demand inducement?

Exc 34 a)

$$\left(y = (\mu_1 + s_1)p_1 + (\mu_2 + s_2)p_2 \right)$$

Let's derive the first-order-conditions for s_1 and s_2:

$$\frac{\partial u(y, s_1, s_2)}{\partial s_1} = \frac{\partial(-e^{-\eta y} - 0{,}5\, s_1^2 - 0{,}5\, s_2^2)}{\partial s_1} = (-e^{-\eta y}) \cdot (-\eta) \cdot \underbrace{p_1}_{\frac{dy}{ds_1}} - s_1 \overset{!}{=} 0$$

$$\Leftrightarrow s_1 = \eta \cdot p_1 \cdot e^{-\eta y}$$

$$\frac{\partial u(y, s_1, s_2)}{\partial s_2} = (-e^{-\eta y}) \cdot (-\eta) \cdot p_2 - s_2 \overset{!}{=} 0$$

$$\Leftrightarrow s_2 = \eta \cdot p_2 \cdot e^{-\eta y}$$

From the two above equations, we see that the optimal solutions s_1 and s_2 will satisfy the following:

$$\frac{s_1}{s_2} = \frac{\eta \cdot p_1 \cdot e^{-\eta y}}{\eta \cdot p_2 \cdot e^{-\eta y}} = \frac{p_1}{p_2}$$

So, the optimal proportion is equal to the proportion of profit margins.

Exc. 34 b)

First, let us note that if p_1 increases, y has to increase as well. The reason is:

If y decreased, then by the FOCs from a), s_1 and s_2 would increase, which would yield a higher y.

So we know that y will increase if p_1 increases. But then, s_2 decreases from the FOC with s_2.

Hence: An increase in the profit margin of service 1 leads to less inducement of service 2.

The effect on s_1 is a priori unclear as a higher p_1 leads to a substitution effect increasing s_1 but also to an income effect reducing s_1 (as y increases). However, we could get a more precise result here using the implicit function theorem:

We know from the FOC that $\underbrace{\eta e^{-\eta y} \cdot p_1 - s_1}_{\text{define as } F(p_1, s_1)} = 0$

$$\rightsquigarrow \text{IFT gives:} \quad \frac{\partial s_1}{\partial p_1} = - \frac{\frac{\partial F}{\partial p_1}}{\frac{\partial F}{\partial s_1}} = \dots$$

Further calculation shows: If η is large, $\frac{\partial s_1}{\partial p_1}$ is positive,

and if η is small, $\frac{\partial s_1}{\partial p_1}$ is negative.

Exc 34 c)

Private patients will receive 2,3 times as much demand inducement as publicly insured patients (in the model).

If the 2,3 multiplier would be reduced, more demand inducement of publicly insured would result (as clinics want to keep their income).

Exercise 35

A clinic offer 2 services. Demand for service i is $M_i + s_i$ where $M_i > 0$ is the primary demand and s_i is the induced demand for service $i \in \{1, 2\}$. The two services are offered in separate units. Each unit has a leader who chooses the inducement level of this unit. The unit leader receives an income bonus that depends positively on the revenues of his own unit an negatively on the revenues of the other unit (e.g. there is some relative performance bonus). The head of unit i maximizes therefore the utility function $2\sqrt{p_i(1+s_i) - \alpha p_j(1+s_j)} - s_i$ where $\alpha \in (0,1)$ is a parameter measuring the magnitude of relative performance pay.

a) Assume $p_1 = p_2 = 1$ and derive the optimal inducement levels the unit leaders will choose.

b) Assume $p_1 = 1.1$ and $p_2 = 1$ and let $\alpha = 1/2$. Derive the optimal inducement levels the unit leaders will choose.

c) Compare your results with the results in exercise 34.

Exc. 35 a) $u_i = 2\sqrt{p_i(1+s_i) - \alpha\, p_j(1+s_j)} - s_i$, $p_1 = p_2 = 1$

We consider the FOC of unit leader i:

$$\frac{\partial u_i}{\partial s_i} = \frac{2 \cdot p_i \cdot \frac{1}{2}}{\sqrt{p_i(1+s_i) - \alpha\, p_j(1+s_j)}} - 1 \overset{!}{=} 0$$

$$\overset{p_i = p_j = 1}{\Leftrightarrow} \quad 1 = \sqrt{1 + s_i - \alpha(1+s_j)}$$

$$\Rightarrow \quad 1 = 1 + s_i - \alpha(1+s_j)$$

As the problem is identical for both unit leaders, we can assume $s_i = s_j$:

$$\Rightarrow 1 = 1 + s_i - \alpha(1+s_i)$$

$$\Leftrightarrow \alpha = (1-\alpha)\, s_i$$

$$\Leftrightarrow s_i = \frac{\alpha}{1-\alpha}$$

Both leaders will induce the amount $\frac{\alpha}{1-\alpha}$.

Exc. 35 b)

We get the same FOC as before.

First, for unit 1:

$$\frac{du_1}{ds_1} = \frac{2 \cdot 1{,}1 \cdot \frac{1}{2}}{\sqrt{1{,}1(1+s_1) - \alpha(1+s_2)}} - 1 \overset{!}{=} 0$$

$$\Leftrightarrow \quad 1{,}1 = \sqrt{1{,}1(1+s_1) - \alpha(1+s_2)}$$

$$\Rightarrow \quad 1{,}21 = 1{,}1(1+s_1) - \alpha(1+s_2)$$

$$\Leftrightarrow \quad 1{,}1(1+s_1) = 1{,}21 + \alpha(1+s_2)$$

Now, similar for unit 2:

$$1+s_2 - \alpha \cdot (1+s_1) \cdot 1{,}1 - 1 \overset{!}{=} 0$$

$$\Leftrightarrow \quad s_2 - \alpha \underbrace{(1+s_1) \cdot 1{,}1}_{\text{plug in from above}} = 0$$

$$\Rightarrow \quad s_2 - \alpha \cdot (1{,}21 + \alpha(1+s_2)) = 0$$

$$\Leftrightarrow \quad 1{,}21\alpha + \alpha^2 = s_2(1-\alpha^2)$$

$$\Rightarrow \quad s_2 = \frac{1{,}21\alpha + \alpha^2}{1-\alpha^2} \overset{\alpha = \frac{1}{2}}{=} 1{,}14$$

in Exc a), s_2 would have been 1 for $\alpha = \frac{1}{2}$.

Exc. 35c)

S_2 increases as a response to an increase in p_1 while it decreased in Exc. 34.

The reason is that a higher p_1 makes it easier for unit 1 to generate revenue and the unit leader of unit 2 tries to compensate by inducing more. This is a problem for study designs as in the second wave of SID studies: If decisions are made by competing units, price increases in one service can then increase inducement in other services.