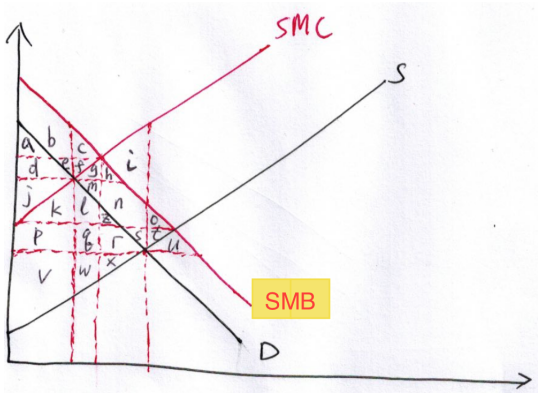
Homework 8 (36 Points)

Problem 1 (8 Points)

The following graph illustrates the market for a good that generates both positive and negative externalities[1]. Note: the government has not imposed any tax or subsidy on the market. Hence the market is at its free-market equilibrium.



SMB: social marginal benefit; SMC: social marginal cost

Find out the following:

1. Consumer surplus + Producer surplus

   `a+d+j+k+l+p+q+r+v+w+x+z`

2. External benefit

   `b+c+e+f+g+h+m+n+s`

3. External cost

   `g+h+i+k+l+m+n+p+q+r+s+v+w+x+z`

4. Deadweight loss

   `i`

[1]For example, self-driving cars can both reduce road accidents and generate pollution and congestion.

Problem 2 (8 Points)

In a village, each person has the following willingness to pay for beer:

1^{st} bottle	\$5
2^{nd}	4
3^{rd}	3
4^{th}	2
5^{th}	1
Further bottles	0

1. The cost of producing beer is \$1.50, and the competitive suppliers sell it at this price. (The supply curve is horizontal.) How many bottles will each villager consume? What is each person's consumer surplus? (2 Points)

   At a price of \$1.50, each person will consume 4 bottles of beer. Each consumer's total willingness to pay is \$14 (= \$5 + \$4 + \$3 + \$2). The total spent by each person on beer is \$6 (= \$1.50 $\times$ 4). Therefore, each consumer receives \$8 in consumer surplus (=\$14 - \$6).

2. Suppose producing beer creates pollution. Each bottle has an external cost of \$1. Taking this additional cost into account, what is total surplus per person? (total surplus per person = total surplus/number of people) (2 Points)

   Each consumer receives consumer surplus = \$8 and generates \$4 in external cost. Total producer surplus = 0, since producers are selling at marginal cost and make 0 profit. Total surplus $TS = CS + PS -$ total external cost $= 8N + 0 - 4N$, where N is the number of villagers. Therefore total surplus per person = \$4.

3. The mayor of the village imposes a $1 tax on beer. What is consumption per person now? Calculate each person's consumer surplus and total surplus per person. Based on your calculations, would you support the mayor's policy? (4 Points)

   The $1 tax raises the price of a bottle of beer to $2.50. (The entire tax will be borne by consumers because supply is perfectly elastic.) Each villager will purchase only 3 bottles at the higher price and each consumer's total willingness to pay is now $12 (= $5 + $4 + $3). Each villager pays $7.50 (= $2.50 × 3) in total. Therefore, each villager receives $4.50 ($12 - $7.50) in consumer surplus and generates $3 in external cost ($1 per bottle x 3 bottles). The government collects $3 per villager in tax revenue. Total surplus per person is therefore equal to $4.50 - $3.00 + $3.00 = $4.50. Since this is higher than $4, we should recommend the mayor's policy.

Problem 3 (10 points)

Services like Uber are called **two-sided markets**: the riders are on one side and the drivers are on the other side. Two-sided markets have an important feature: the more users there are on the other side, the happier users on this side are. For example, if you are a potential rider that uses Uber, then the more Uber drivers there are, the happier you are because it means you can get a ride more easily, everything else being equal. In other words, when a driver joins Uber, she will make you happier. Similarly, by using the Uber app as a potential rider, you are making Uber drivers happier. This has been called **indirect network externality**.

1. Explain in what sense is indirect network externality an externality, and in what sense it may not be a true externality.

   Since the action of people on one side will positively affect the people on the other side, it can be considered a positive externality. However, people are actually "getting paid" for this positive externality since the platform takes this externality into consideration in its pricing decision. Therefore, it is not an externality in a strict sense.

2. What other services that you know are two-sided platforms? List at least three.

   Didi, Taobao, Dianping, ...;

3. Suppose the demand function for the two sides of the market is

$$Q_A = 1 - 0.3p_A + 0.5Q_B \tag{1}$$
$$Q_B = 1 - 0.6p_B + 0.5Q_A$$

, i.e., demand on side A (Q_A) depends on the the amount of users on side B (Q_B) and vice versa. Suppose the platform company's profit function is

$$\pi = p_A Q_A + p_B Q_B$$

Calculate the optimal price (p_A^*, p_B^*) this platform company should charge each side of the market[2].

`Solving (1)` $\Rightarrow$

$$Q_A = 2 - 0.4p_A - 0.4p_B$$
$$Q_B = 2 - 0.2p_A - 0.8p_B$$

`Hence, optimizing the profit function with respect to` p_A `and` p_B `gives us:`

$$\frac{\partial \pi}{\partial p_A} = 2 - 0.8p_A - 0.6p_B = 0$$
$$\frac{\partial \pi}{\partial p_B} = 2 - 0.6p_A - 1.6p_B = 0$$

$\Rightarrow$

$$p_A^* = \frac{50}{23}, p_B^* = \frac{10}{23}, Q_A^* = \frac{22}{23}, Q_B^* = \frac{20}{23}$$

[2]Hint: To solve this problem, first solve Q_A and Q_B as functions of p_A and p_B, then maximize profit by solving

$$\frac{\partial \pi}{\partial p_A} = 0, \ \frac{\partial \pi}{\partial p_B} = 0$$

, from which you should be able to obtain the optimal prices (p_A^*, p_B^*).

4. Compare with the no indirect network externality case:

$$Q_A = 1 - 0.3p_A$$
$$Q_B = 1 - 0.6p_B$$

Do the optimal prices increase or decrease for side A and B when there is indirect network externality? Can you explain why?

Without indirect network externality,

$$\frac{\partial \pi}{\partial p_A} = 1 - 0.6p_A = 0 \Rightarrow p_A^* = \frac{5}{3}$$
$$\frac{\partial \pi}{\partial p_B} = 1 - 1.2p_B = 0 \Rightarrow p_B^* = \frac{5}{6}$$

Hence, with indirect network externality, optimal prices for side A increases, while optimal price for side B decreases. This is because everything else being equal, side B tends to have higher elasticity of demand than side A (see (1)). Rysman (2009) offers insight into the pricing behavior of two-sided markets as follows:

"In any market, prices typically fall as the price elasticity of demand increases, but in a two-sided market the effect can be even larger: The low price on one side not only attracts elastic consumers on that side but also, as a result, leads to higher prices or more participation on the other side. The increased value extracted from the other side magnifies the value of having consumers on the first side, which leads to a yet bigger price decrease and quantity increase for the side that experiences the increase in elasticity ... Such seeming anomalies as price below marginal cost or even negative prices can easily arise in a two-sided market. For example, a platform might charge a price below cost on one side if those agents have a large price elasticity and their participation attracts a large number of participants on the other side who are relatively price inelastic" -- Rysman (2009)

Problem 4 (10 points)

Read the articles

- Djankov, S. 2021. "How do companies avoid paying international taxes? And will countries agree on new rules to reform the system?" PIIE.
- Bunn, D. 2021. "A Global Minimum Tax and Cross-Border Investment: Risks & Solutions" Tax Foundation[3].

1. Summarize the OECD two-pillar plan to reform international taxation rules. (2 Points)

   (1) Allocate taxing rights to market jurisdictions where final sales are made or users are based.
   (2) A global minimum corporate tax of 15 percent.

2. According to Djankov (2021), what are some of the limitations of the OECD plan? (4 Points)

   Governments could adopt other tax perks such as R&D tax credits to attract firms. Without additional legislation, competition between governments to set the lowest corporate tax rate could be replaced by competition to grant the most lavish R&D tax credits, allowing multinational companies to continue to erode tax revenues and maximize profits.

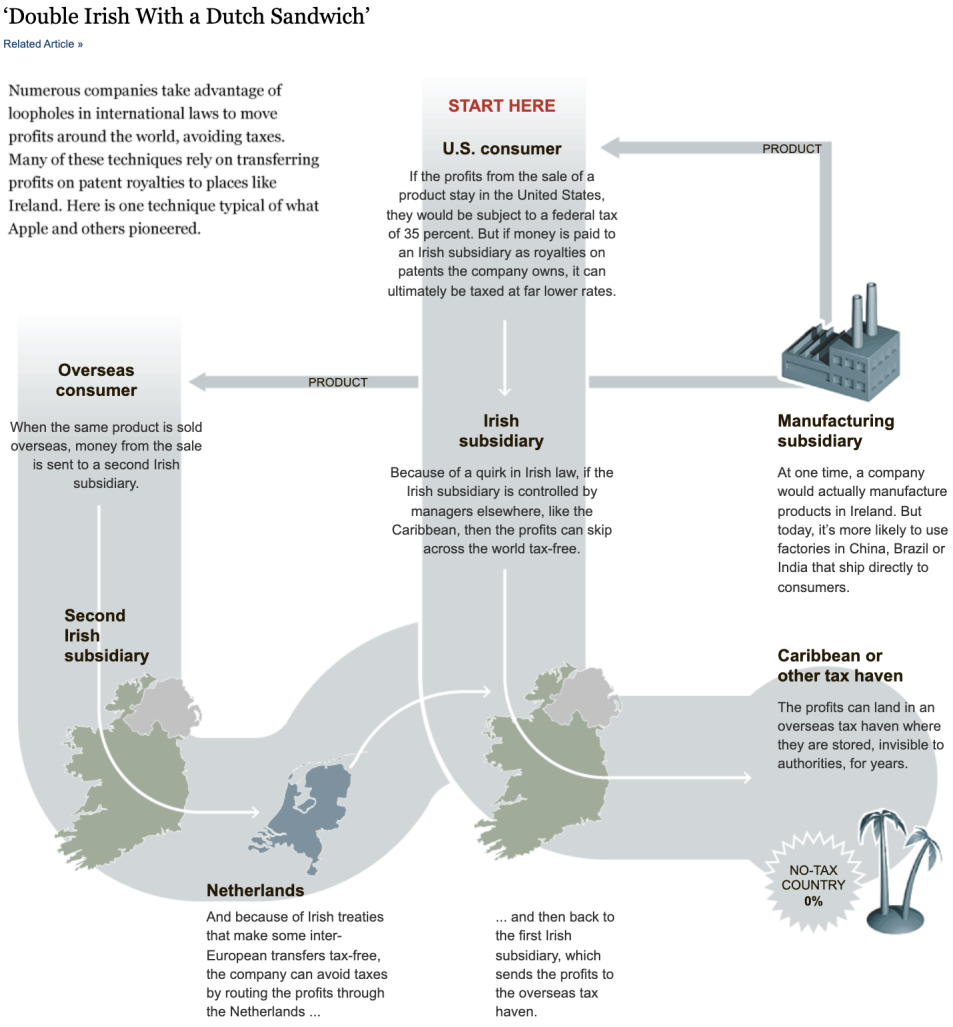
3. According to Bunn (2021), what could be some of the negative consequences of the OECD plan and how to mitigate them? (4 Points)

   While the OECD plan can address the use of low-tax jurisdictions by multinational companies, it may increase the cost of investing and hiring. The global minimum tax can act like a direct tax on foreign investment. Companies more exposed to the global minimum tax will likely respond by reducing foreign operations *as well as* domestic support functions, with negative spillover effects to the local communities where they are located. To minimize these negative consequences, Bunn (2021) advocates tax exemption of business costs including start-up costs, ongoing employment costs, and the costs of expansion and new hiring.

[3] In particular, read the sections after "A Simple Example of Taxes on Global Companies and Investment Decisions."

Problem 5 (bonus: 5 points)

The "Double Irish Dutch Sandwich" was a tax strategy used by Google, Apple, Facebook and many other corporations to shift profits by sending royalty payments for intellectual property to jurisdictions with no corporate income taxes. Can you describe how it worked?



See "Tax Avoidance Strategy."