Externalities

• An externality occurs whenever the activities of one economic agent affect the activities of another agent in ways that are not taken into account by the operation of the market.

Examples:
- One firm produces down river from another firm. The first firm pollutes the river and prevents the second from producing.
- Doctor works next door to a noisy factory.
- I care what my daughter eats.

A Downriver Externality

• Consider the firms on the river example. Both firms use only labor as an input.
  - The upriver firm produces $Y$ with a production function of $Y = g(L_i)$.
  - The downriver firm produces $X$. Its production is affected by the upriver firm’s production: $X = f(L_j; Y)$, where: $\frac{\partial X}{\partial Y} < 0$

The Social Optimum

• Suppose there is a fixed amount of labor $L$ in the economy.
• Suppose prices for $X$ and $Y$ are $P_x$ and $P_y$.
• The total value of output is $P_xX + P_yY$.
• At the social optimum, labor is allocated to the two firms such that the total value of output in the economy is maximized:

$$\max_{L_i, L_j} P_x(L_i; Y) + P_y(Y(L_j))$$

s.t. $L_i + L_j = L$

First Order Condition at the Social Optimum

• The first order conditions are:

$$\frac{\partial V}{\partial L_i} = P_x \left( \frac{\partial X}{\partial L_i} - \frac{\partial X}{\partial Y} \frac{\partial Y}{\partial L_i} \right) - \lambda = 0$$
$$\frac{\partial V}{\partial L_j} = P_y \left( \frac{\partial Y}{\partial L_i} - \frac{\partial Y}{\partial Y} \frac{\partial Y}{\partial L_i} \right) = P_y \frac{\partial Y}{\partial L_i}$$

$$\frac{\partial W}{\partial \lambda} = L_i - L_j = 0$$

This “extra” term arises because of the externality.

The Market Will Not Lead to the Social Optimum

• In a competitive market, price taking maximize profits:
  - $\pi_x = P_x X - wL_i$, and $\pi_y = P_y Y - wL_j$.
• The first order conditions in a competitive market are:

$$\frac{\partial \pi_x}{\partial L_i} = P_x \frac{\partial X}{\partial L_i} - w = 0$$
$$\frac{\partial \pi_y}{\partial L_j} = P_y \frac{\partial Y}{\partial L_j} - w = 0$$

This is not the same f.o.c. as the social optimum. Firm Y ignores the externality it imposes on X and produces too much.

Can the Market be Fixed?

• Pigouvian taxes
  - Impose a tax ($t$) on the production of $Y$ such that it chooses to cut back production to the socially optimal level.
  - $Y$’s profits after the tax are $\pi_y = (P_y - t)Y - wL_j$.
  - $Y$’s new f.o.c. is: $\frac{\partial \pi_y}{\partial L_j} = (P_y - t) \frac{\partial Y}{\partial L_j} - w = 0$
  - For the socially optimal amount: $t = -P_y \frac{\partial Y}{\partial Y}$
Can the Market be Fixed? (II)

- The firms can merge.
  - If X and Y merge, the new super firm will maximize joint profits: \( \pi = P_y Y + P_x X - w(L_x + L_y) \)
  - The first order conditions for the super firm are:

\[
\begin{align*}
\frac{\partial \pi}{\partial L_x} &= P_x \left( \frac{\partial X}{\partial L_x} \right) - w = 0, \\
\frac{\partial \pi}{\partial L_y} &= P_y \left( \frac{\partial Y}{\partial L_y} \right) - w = 0.
\end{align*}
\]

This is exactly the f.o.c. for the social optimum. By merging, the externality has been “internalized”.

Does the Market Need Fixing?

- Suppose that firm X owned the river. Then it could charge the firm Y for the externality it imposes and the socially efficient outcome would result.
- Suppose that firm Y owned the river. The socially efficient would still occur!
- Why? If it was socially efficient for X to have Y reduce its output, it would pay Y not to produce.

The Coase Theorem

- Coase Theorem: In the absence of transaction costs, the socially efficient outcome will occur, regardless of the assignment of property rights.
- Externalities are not caused by one party—they are caused by the simultaneous actions of two or more parties.
  - For the downriver externality, you need two things: a firm Y that pollutes a river and a firm X that locates downriver.

The Beneficent Effects of Assigning Property Rights

- The assignment and enforcement of a property right moves an externality (utility or productivity interactions not dealt with by the market) into the market.
- It is the lack of (or poor) assignment of property rights that causes the externality and leads ultimately to inefficient market outcomes.
  - Markets are necessarily incomplete if property rights are not assigned.

Coase Theorem Example

- A doctor (M. Welby, MD) operates next door to a noisy candy manufacturer (W. Wonka).
  - The value of the doctor’s output is $100.
  - The value of the candy firm’s output is $50.
- Dr. Welby cannot operate at all if the candy machines are running.
- The socially efficient outcome is that Mr. Wonka shut down.

M. Welby and W. Wonka

- Suppose that Dr. Welby has a right to peace and quiet.
  - The efficient outcome happens and Mr. Wonka closes shop. (sorry Charlie!).
- Suppose instead that Mr. Wonka convinces the city council to decree that he has a right to make noise.
  - Dr. Welby will pay Mr. Wonka at least $50 to shut down.
  - The efficient outcome still happens—no candy is produced.
Transaction Costs

- The conclusion of the Coase Theorem depends crucially on low cost bargaining.
  - Suppose Dr. Welby had to pay $50 for a lawyer to help negotiate with the intractable Mr. Wonka.
  - In that case, the assignment of property rights would determine whether the socially optimal outcome happened.

Why Do Firms Exist?

- Recall that one solution to the externality problem is merger.
- By merging, the combined Welby-Wonka operation’s optimal private choices would also be socially optimal.
- The advantage of merging to form a firm is reduced transactions costs of bargaining.
  - There is less need for Mr. Welby to hire a lawyer if Wonka and Welby work for the same company.
- In a sense, firms exist to “internalize” high transactions cost interactions.

Public Goods

- Public goods are goods for which it is inherently difficult to assign property rights.
  - The classic example is national defense.
- The defining characteristics of public goods are nonexclusivity and nonrivalry.
  - Nonexclusivity: It is very costly or impossible to exclude those who have not paid from enjoying the good.
  - Nonrivalry: The consumption of additional units involves zero social marginal costs of production.

Examples of Public Goods

<table>
<thead>
<tr>
<th>Rival</th>
<th>Nonexclusive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candy, BMW’s, Houses</td>
<td>Fishing ponds, Public parks</td>
</tr>
<tr>
<td>Scrambled satellite dish signals, Bridges</td>
<td>National defense, Justice, Internet broadcasts, Lighthouses</td>
</tr>
</tbody>
</table>

Question to ponder: Is education a public good? Is it exclusive? Is it rival?

Market Provision of Public Goods

- In private goods markets, we have seen that an efficient outcome requires that the PPF must be tangent to the “society’s” utility curve (“social” MRS = RPT).
- Suppose there are two goods in the economy—a private good (G) and a public good (P).
- The marginal rate of substitution for any individual \(i\) is:
  \[
  MRS'(P \text{ for } G) = \left( \frac{dG}{dP} \right) = \frac{MU'_G}{MU'_P}
  \]

Market Provision of Public Goods (II)

- The social MRS is the total amount everyone would give up of G to get an extra unit of P.
  - The social MRS is the sum of the individual MRS:
    \[
    SMRS(P \text{ for } G) = \sum \left( -\frac{dG}{dP} \right) = \sum MRS'
    \]
- The social optimum (Pareto efficiency) requires that the SMRS be equal to the rate of product transformation (RPT).
Market Provision of Public Goods (III)

- If a market provided P, however, each person would pick P and G to equate their own MRS to the RPT of P for G.
  \[ RPT (P \text{ for } G) = MRS (P \text{ for } G) = \frac{MU_P}{MU_G} < SMRS \]
- The amount of public good purchased would be less than optimal.
- Each individual in the market ignores the positive externality caused by the purchase of more of the the public good (“free rider” problem).

Lindahl Taxes for Public Goods

- How much should the government tax each person to fund the public good?
- In a Lindahl pricing equilibrium, the government imposes taxes on each individual in proportion to the benefit they derive from the public good.
  - This information is hard to collect.
  - Everyone has an incentive to underreport how much benefit they derive from the public good.
- If willingness to pay information can be collected, the sum of all taxes collected exactly equals the optimal amount of spending on the public good.

Choosing The Right Taxes

- Welby chooses P and G such that his MRS equals the price ratio he faces:
  \[ \frac{a_1P}{a_2} = MRS_{Welby} (P \text{ for } G) \]
- Wonka chooses P and G such that his MRS equals the price ratio he faces:
  \[ \frac{a_2P}{a_1} = MRS_{Wonka} (P \text{ for } G) \]
- Producers maximize profits by setting RPT equal to the price ratio:
  \[ \frac{P}{P_e} = RPT (P \text{ for } G) \]

Lindahl Taxes—An Example

- Two people in an economy. Two goods:
  - A private good (G)—price = \( p_G \)
  - A public good (P)—price = \( p_P \)
- The government charges taxes:
  - \( P_g * a_1 \) to the first person, say Welby
  - \( P_g * a_2 \) to the second person, say Wonka
  - Where \( a_1 + a_2 = 1 \)

Lindahl Taxes and Private Choices

- Welby chooses P and G such that his MRS equals the price ratio he faces:
  \[ \frac{a_1P}{a_2} = MRS_{Welby} (P \text{ for } G) \]
- Wonka chooses P and G such that his MRS equals the price ratio he faces:
  \[ \frac{a_2P}{a_1} = MRS_{Wonka} (P \text{ for } G) \]
- Producers maximize profits by setting RPT equal to the price ratio:
  \[ \frac{P}{P_e} = RPT (P \text{ for } G) \]
Lindahl Taxes and the Social Optimum

- At the Lindahl tax equilibrium, the socially optimal levels of the public and private goods will be produced.
  - Add Welby and Wonka’s MRS’s:
    \[ MRS_{Welby} (P \text{ for } G) + MRS_{Wonka} (P \text{ for } G) = \frac{aP_P}{P_P} + \frac{a_P P_P}{P_P} = \frac{P_P}{P_P} \]
  - Compare with the firm’s profit maximizing condition:
    \[ MRS_{Welby} (P \text{ for } G) + MRS_{Wonka} (P \text{ for } G) = \frac{P_P}{P_P} = RPT (P \text{ for } G) \]
  - But this is exactly the condition for the social optimum

But Will the Government Get it Right?

- With Pigouvian taxes and the assignment of property rights, the government has tools to internalize externalities
- With Lindahl taxes, the government has a tool to allow the market to provide efficiently for public goods.
- If fixing these problems is so easy, then why is it rare for the government to get it right?
  - Collecting information about what is optimal may be difficult or impossible.
  - When there are fundamental disagreements about what is a public good, then under democratic government, there may be no right answer.