Public Goods (Chapters 7-9)

Part-1
Public Goods

• Whether a good is a private or public good depends on two factors:
  – **Non-rival in consumption**: One’s consumption of the good does not affect the others’ opportunity to consume the same good.
  – **Non-excludable**: One can not exclude the other from consuming the good.
## Public Goods

### TABLE 7-1

<table>
<thead>
<tr>
<th>Is the good rival in consumption?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Private good (ice cream)</td>
<td>Impure public good (cable TV)</td>
</tr>
<tr>
<td>No</td>
<td>Impure public good (crowded city sidewalk)</td>
<td>Pure public good (national defense)</td>
</tr>
</tbody>
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<th>Is the good excludable?</th>
<th>Yes</th>
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Optimal Provision of Public Goods
Private vs. Public Goods

• Assume that there are two individuals, who are deciding between consuming two goods (X and Y). For simplicity, assume that X is a numeraire good \( (p_x = $1) \).
  
  – **Numeraire good**: A good for which the price is set at $1 in order to model choice between goods, which depends on relative, not absolute prices.
Optimal Provision of Public Goods
Private vs. Public Goods

• The utility functions of the two individuals are given as follows:
  \[ U_1(X_1, Y_1) \]
  \[ U_2(X_2, Y_2) \]
Optimal Provision of Public Goods
Private vs. Public Goods

• **Case 1: X and Y are private goods**
  - How to find the free-market equilibrium price and demand for Y?
  1. For different values of $p_Y$ ($p_Y^1, p_Y^2, p_Y^3...$), find the optimal consumption values of Y for both individuals ($Y_{11}^*, Y_{12}^*, Y_{13}^*; Y_{21}^*, Y_{22}^*, Y_{23}^*$) using their budget constraints and the following equalities:

$$MRS_{Y,X}^1 = \frac{MU_Y^1}{MU_X^1} = \frac{p_Y}{p_X} = p_Y$$

$$MRS_{Y,X}^2 = \frac{MU_Y^2}{MU_X^2} = \frac{p_Y}{p_X} = p_Y$$
Optimal Provision of Public Goods
Private vs. Public Goods

• Case 1: X and Y are private goods
  – How to find the free-market equilibrium price and demand for Y?
    2. To find the aggregate demand for Y, sum the individual demands at each price level \( p_Y^1, p_Y^2, p_Y^3 \ldots \)
    3. The equilibrium will take place at the point where the aggregate demand curve (SMB) intersects the supply curve (SMC).
Optimal Provision of Public Goods
Private vs. Public Goods

- **Case 1: X and Y are private goods**
Optimal Provision of Public Goods
Private vs. Public Goods

• **Case 1: X and Y are private goods**
  – In equilibrium, the producer will supply 3 units of cones and
    • Ben will consume 2 units
    • Jerry will consume 1 unit
  – Therefore, in equilibrium
    \[
    MRS_{Y,X}^1 = MRS_{Y,X}^2 = p_Y
    \]
Optimal Provision of Public Goods
Private vs. Public Goods

• Case 1: X and Y are private goods
  – In equilibrium, we also know that the firm will produce up to the point where

\[ MC = p_Y \]

  – Therefore, in equilibrium

\[ MRS_{Y,X}^1 = MRS_{Y,X}^2 = MC = p_Y \]
\[ SMB = SMC \]
Optimal Provision of Public Goods
Private vs. Public Goods

- **Case 2: X is private and Y is public**
  - How to find the free-market equilibrium price and demand for Y?
    1. Same as Case-1.
    2. To find the aggregate demand for Y, sum the individual willingness to pay of the two individuals at each quantity level.
    3. The equilibrium will take place at the point where the aggregate demand curve (SMB) intersects the supply curve (SMC).
Optimal Provision of Public Goods
Private vs. Public Goods

- **Case 2:** X is private and Y is public
Optimal Provision of Public Goods
Private vs. Public Goods

- **Case 2: X is private and Y is public**
Optimal Provision of Public Goods
Private vs. Public Goods

• Case 2: X is private and Y is public
  – In equilibrium, the producer will supply 5 units of missiles and
    • Ben will consume 5 units
    • Jerry will consume 5 units
  – Therefore, in equilibrium
    \[ MRS_{Y,X}^1 \neq MRS_{Y,X}^2 \neq p_Y \]
    \[ MRS_{Y,X}^1 + MRS_{Y,X}^2 = p_Y \]
Optimal Provision of Public Goods
Private vs. Public Goods

• Case 2: X is private and Y is public
  – In equilibrium, we also know that the firm will produce up to the point where

\[ MC = p_Y \]

– Therefore, in equilibrium

\[ MRS_{Y,X}^1 + MRS_{Y,X}^2 = MC = p_Y \]
\[ SMB = SMC \]
Optimal Provision of Public Goods

Private vs. Public Goods

- **For private goods**, it is socially optimal for firms to produce until the marginal cost equals the benefit to the marginal consumer.

- **For public goods**, it is socially optimal for firms to produce until the marginal cost equals the benefit to all consumers combined.
Optimal Provision of Public Goods
Private vs. Public Goods

Example:
- 2 individuals, 2 goods (X, Y)
- X is private (food), Y is public (fireworks)
- Both goods cost $1/unit.
- Both individuals have an income of $100.
- They both have the following utility function
  \[ U = 2\log(X) + \log(Y) \]
- \textbf{Q:} What is the socially optimal level of Y?
Optimal Provision of Public Goods
Private Provision of Public Goods

• Example:
  – Q: How much Y would the two individuals consume?
Optimal Provision of Public Goods

Private Provision of Public Goods

• In general, the private sector **under-provides** public goods due to the free rider problem.
  
  – **Free rider problem**: When an investment has a personal cost but a common benefit, individuals will under-invest.
Optimal Provision of Public Goods

Private Provision of Public Goods

• Three scenarios under which private provision might overcome the free rider problem:
  
  1. Some individuals care more than others (higher incomes or stronger tastes)
  
  2. **Altruism**: When individuals value the benefit and costs to others in making their consumption choices.
  
  3. **Warm glow**: Individuals care about both the total amount of both the total amount of the public good and their particular contributions as well.
Optimal Provision of Public Goods

Private Provision of Public Goods

• **Example:** Now assume that the two individuals differ in their incomes. ($125 for 1 versus $75 for 2)

• Neither of the three scenarios guarantee a complete solution to the free rider problem.
Optimal Provision of Public Goods

Public Provision of Public Goods

• The government can determine the socially optimum amount of the public good and mandate private actors to provide that amount.
Optimal Provision of Public Goods

Public Provision of Public Goods

- The Issue – Crowding Out
  - Crowd-out: As the government provides more of a public good, the private sector will provide less.
Optimal Provision of Public Goods

Public Provision of Public Goods

- **Example:** Assuming they both have the same income and utility functions, find the private provision of the two individuals when
  - The government itself increases the total consumption by 26.6 units by taxing each individual $13.3.
Optimal Provision of Public Goods

Public Provision of Public Goods

- Full crowding-out is rare. Partial crowding-out is much more common and can occur in two different cases:
  - When non-contributors are taxed to finance the provision of the good.
  - Warm glow