Microeconomics

Lecture 7

The Tragedy of the Commons

- Consider a grazing area owned “in common” by all members of a village.
- Villagers graze cows on the common.
- When c cows are grazed, total milk production is f(c), where f’>0 and f”<0.
- How should the villagers graze their cows so as to maximize their overall income?

The Tragedy of the Commons

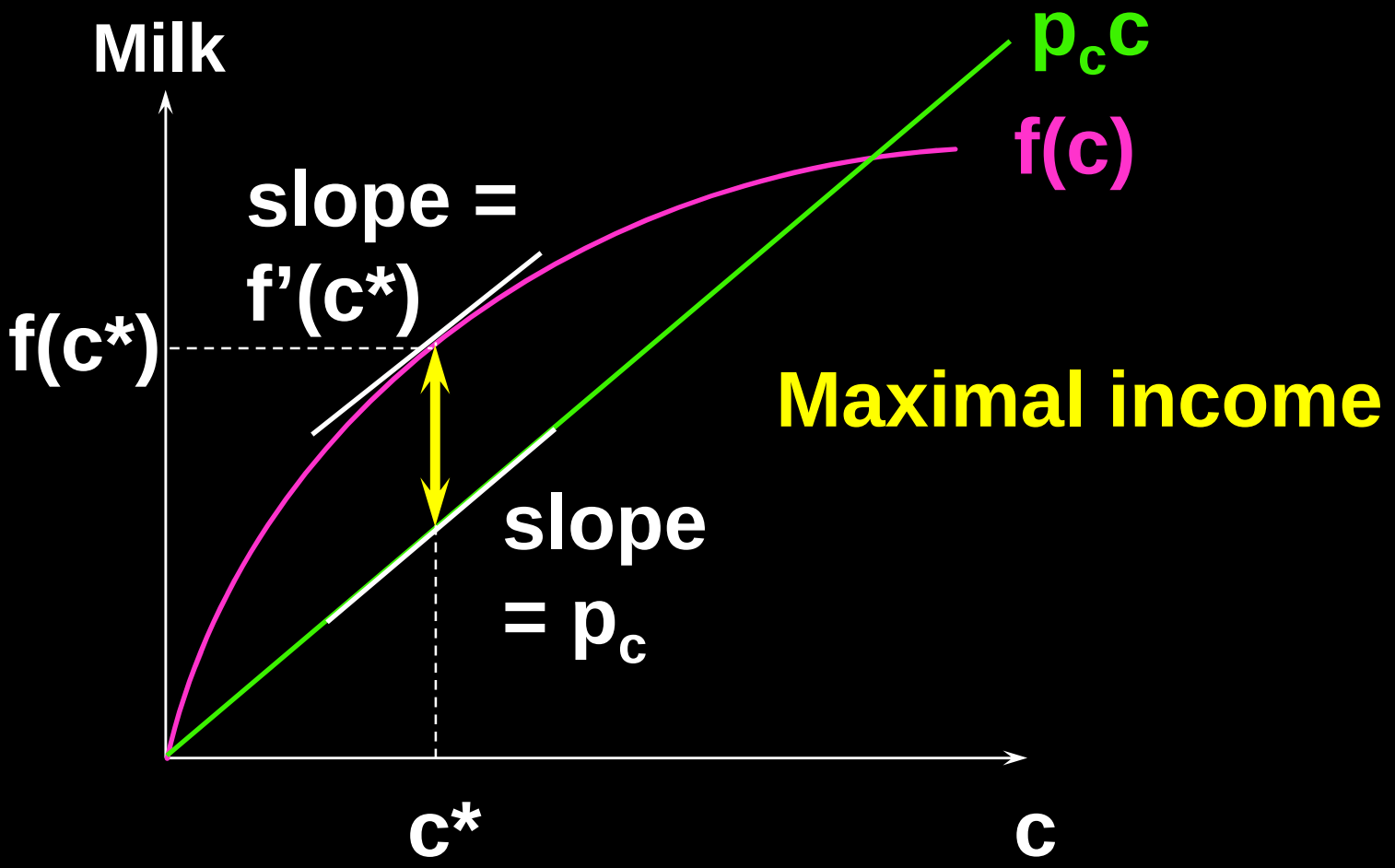
$$\max_{c \geq 0} \Pi(c) = f(c) - p_c c.$$

The income-maximizing number of cows to graze, c*, satisfies

$$f'(c) = p_c$$

i.e. the marginal income gain from the last cow grazed must equal the marginal cost of grazing it.

The Tragedy of the Commons



The Tragedy of the Commons

- For c = c*, the average gain per cow grazed is

$$\frac{\Pi(c^*)}{c^*} = \frac{f(c^*) - p_c c^*}{c^*} = \frac{f(c^*)}{c^*} - p_c > 0$$

because f' > 0 and f" < 0. So the economic profit from introducing one more cow is positive.

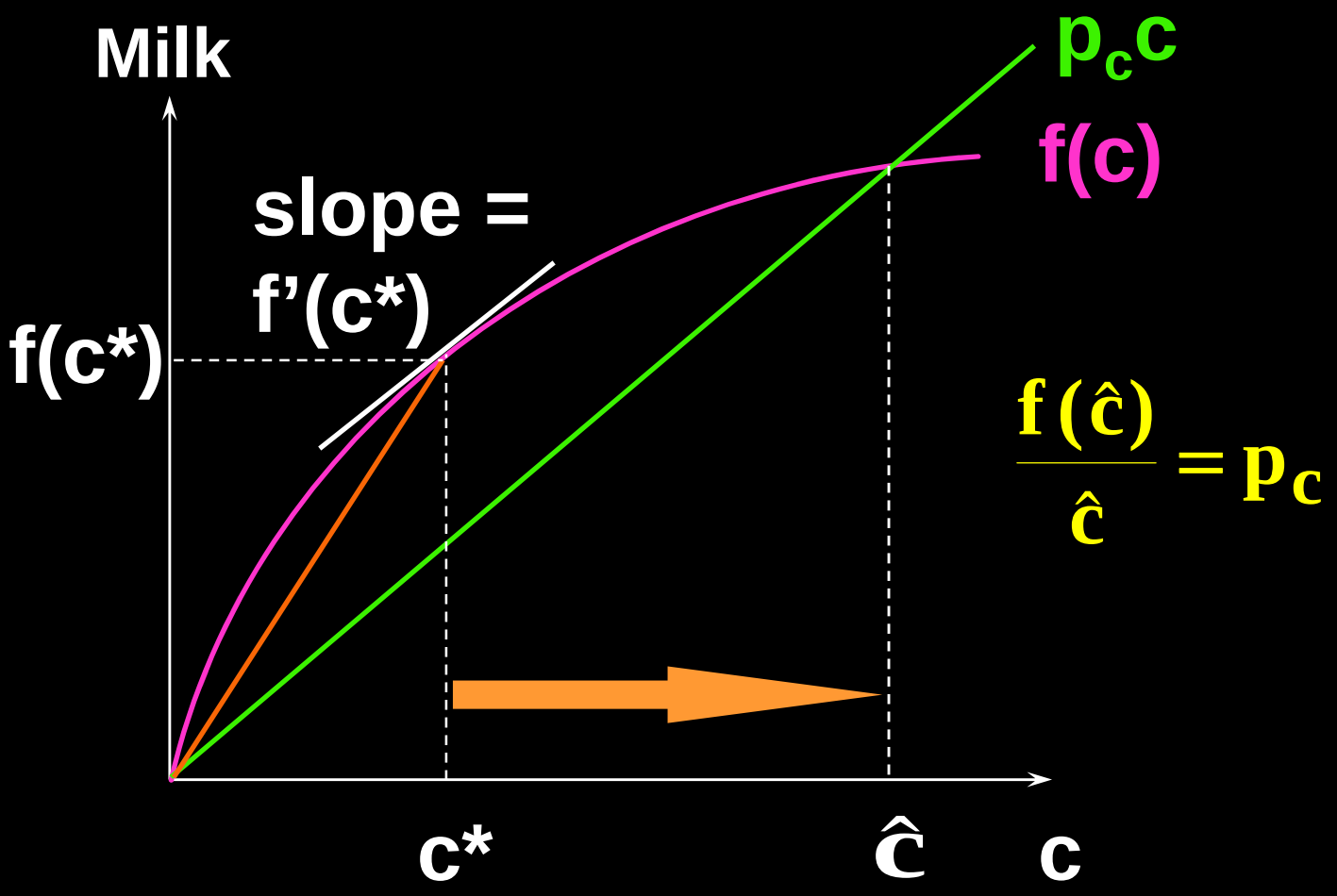
- Since nobody owns the common, entry is not restricted.

The Tragedy of the Commons

- **Entry continues until the economic profit of grazing another cow is zero; that is, until**

$$\frac{\Pi(c)}{c} = \frac{f(c) - p_c c}{c} = \frac{f(c)}{c} - p_c = 0.$$

The Tragedy of the Commons



The commons are over-grazed, tragically.

The Tragedy of the Commons

- **The reason for the tragedy is that when a villager adds one more cow his income rises (by $f(c)/c - p_c$) but every other villager's income falls.**
- **The villager who adds the extra cow takes no account of the cost inflicted upon the rest of the village.**

The Tragedy of the Commons

- **Modern-day “tragedies of the commons” include**
  - **over-fishing the high seas**
  - **over-logging forests on public lands**
  - **over-intensive use of public parks**
  - **urban traffic congestion.**

Demand Revelation

- **A scheme that makes it rational for individuals to reveal truthfully their private valuations of a public good is a revelation mechanism.**
- **E.g. the Groves-Clarke taxation scheme.**
- **How does it work?**

Demand Revelation

- N individuals; i = 1,…,N.
- All have quasi-linear preferences.
- v_i is individual i's true (private) valuation of the public good.
- Individual i must provide c_i private good units if the public good is supplied.

Demand Revelation

- $n_i = v_i - c_i$ is net value, for i = 1,…,N.
- Pareto-improving to supply the public good if

$$\sum_{i=1}^{N} v_i > \sum_{i=1}^{N} c_i \Leftrightarrow \sum_{i=1}^{N} n_i > 0.$$

Demand Revelation

- If $\sum_{i \neq j}^{N} n_i < 0$ and $\sum_{i \neq j}^{N} n_i + n_j > 0$

  or $\sum_{i \neq j}^{N} n_i > 0$ and $\sum_{i \neq j}^{N} n_i + n_j < 0$

  then individual j is **pivotal**; i.e. changes the supply decision.

Demand Revelation

- **What loss does a pivotal individual j inflict on others?**
- **If** $\sum_{i \neq j}^{N} n_i < 0$, **then** $-\sum_{i \neq j}^{N} n_i > 0$ **is the loss.**
- **If** $\sum_{i \neq j}^{N} n_i > 0$, **then** $\sum_{i \neq j}^{N} n_i > 0$ **is the loss.**

Demand Revelation

- **For efficiency, a pivotal agent must face the full cost or benefit of her action.**
- **The GC tax scheme makes pivotal agents face the full stated costs or benefits of their actions in a way that makes these statements truthful.**

Demand Revelation

- **The GC tax scheme:**
- **Assign a cost c_i to each individual.**
- **Each agent states a public good net valuation, s_i.**
- **Public good is supplied if $\sum_{i=1}^{N} s_i > 0$; otherwise not.**

Demand Revelation

- A pivotal person j who changes the outcome from supply to not supply

  pays a tax of $\sum_{i \neq j}^{N} s_i$.

- A pivotal person j who changes the outcome from not supply to supply

  pays a tax of $-\sum_{i \neq j}^{N} s_i$.

Demand Revelation

- GC tax scheme implements efficient supply of the public good.
- But, causes an inefficiency due to taxes removing private good from pivotal individuals.
- Note: Taxes are not paid to other individuals, but to some other agent outside the market.