Lecture 12: Public goods

Economics 336

Introduction

What's wrong with this picture?

Snow removal creates benefits for others not valued by payors – it is underprovided.

While people value snow removal, it is difficult for private firms to provide it profitably:

- How could firms require payment for service?
- Would we want them to?

Snow removal is a *public good*. *Private provision* of snow removal can lead to a *free-rider problem*.

Pure public goods

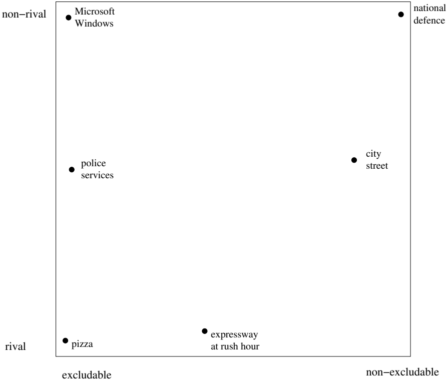
A *pure public good* is a commodity which is

- *non-rival*: Consumption by one person does not limit consumption (of the same unit) by others;
- *non-excludable*: Limiting consumption by others is impossible (or very costly).

As the snow removal example suggests,
the First Welfare Theorem is likely to fail with pure public goods. That is:

Impure public goods

Most public goods are only partially non-rival and non-excludable – *impure public goods*. Examples:



Where would you place:

- broadcast television and cable television?
- a WiFi network?
- a university education?

The privatization debate: Some terminology

In this lecture, we are discussing why and how the state should be involved in providing public goods. A separate question is who should produce them.

- **public (private) provision**: The state (private sector) chooses the allocation of the commodity.
- **public (private) production**: The state (private sector) chooses how the commodity is produced.

For an individual commodity, we can have with public provision, public production, or both.

In public debates over *privatization* of government services, the two issues often get confused.

Graded Exercise

In these cases, do we use public provision? public production?

- health services/health insurance
- streets and highways
- snow removal (in Toronto? in Scarborough?)
- garbage collection (hint: in Toronto, people pay based on size of their garbage bin)

The case for public production is mixed. Private producers may have better incentives to reduce costs due to competition, the profit motive. Public production may be necessary where the *quality* of production is difficult to observe. (Examples?)

Public-private partnerships

Traditionally, contracting out government services to private firms was through *cost-plus contracts*, i.e. paying for the actual cost of production, plus a normal rate of profit.

Recently, contracting out has taken the form of *public-private partnerships* (P3s), in which private firms:

- raise capital, design and build public facilities
- sometimes operate facilities over the long term, charge fees

Examples include hospitals and transit projects, airports, etc.

P3s are controversial – e.g. "Canada Line" subway in Vancouver. Some argue:

- P3s harden budget constraints $\Longrightarrow$ P3s *more* cost effective
- Government cost of borrowing lower $\Longrightarrow$ P3s *less* cost effective

What do you think of these arguments?

Classroom exercise: Voluntary contributions

Voluntary contributions: The Nash equilibrium

Model this as a simultaneous move game.

If each student i contributes g_i, her payoff is

$$U_i = 1.2 \times \frac{1}{N} \sum_{j=1}^{N} g_j + 1 - g_i$$

What is the Nash equilibrium? What is the socially efficient outcome?

Results

-
-

Explanations?

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Efficient provision of public goods

With private goods, we know Pareto efficiency is attained by setting $p_i = MC_i$ in all markets, and producing $X_i = \sum_h D_i^h(p_i)$ of all goods. This ensures for any two goods i, j and two consumers A, B,

$$\frac{\partial U^A/\partial x_i}{\partial U^A/\partial x_j} = \frac{MC_i}{MC_j} = \frac{\partial U^B/\partial x_i}{\partial U^B/\partial x_j}$$

or

$$MRS^A_{ij} = MRT_{ij} = MRS^B_{ij}$$

For public goods this can't work:

- all consumers consume the same quantity G (non-rival);
- no prices to equilibrate market (non-excludable)

Samuelson conditions

Paul Samuelson solved the efficient provision problem in an elegant 1954 paper.

Two consumers A, B, one private good (x_A, x_B), and one public good G.

Feasible allocations:

$$x_A + x_B + C(G) = W \quad \text{(fixed)}$$

A Pareto efficient allocation solves

$$\begin{aligned} \max U_B(x_B, G) \;\text{ s.t. }\; U_A(x_A, G) &= \bar{U}_A \\ x_A + x_B + C(G) &= W \end{aligned}$$

Form the Lagrangean

$$\mathcal{L} = U_B(x_B, G) + \lambda U_A(W - x_B - C(G), G)$$

First-order conditions are:

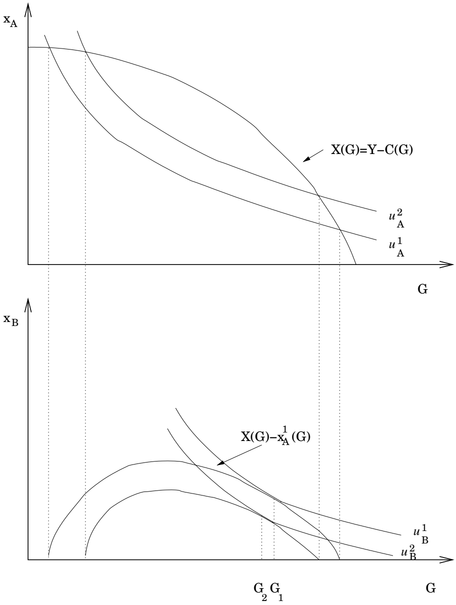
$$\frac{\partial U_B}{\partial x_B} = \lambda \frac{\partial U_A}{\partial x_A}$$

$$\frac{\partial U_B}{\partial G} + \lambda \frac{\partial U_A}{\partial G} = \lambda \frac{\partial U_A}{\partial x_A} C'(G)$$

Divide the second equation by $\lambda \partial U_A / \partial x_A$ and use the first equation to get

$$\frac{\partial U_B/\partial G}{\partial U_B/\partial x_B} + \frac{\partial U_A/\partial G}{\partial U_A/\partial x_A} = C'(G).$$

or $MRS_A + MRS_B = MRT$.



x_A
X(G)=Y−C(G)
u_A^2
u_A^1
G
x_B
$X(G)-x_A^1(G)$
u_B^1
u_B^2
G_2 G_1
G

Allocation and distribution

How does the optimal G depend on planner's attitude to redistribution between A and B (captured by the target utility level $\bar{U}_A$)?

Normally we think the questions of efficient allocation and of equitable distribution are separate. But Samuelson's graph shows this is not the case for public goods.

When the planner wishes to redistribute more from B to A, their willingness to pay for the public good changes (by different amounts), so the efficient quantity changes as well.

So we cannot speak of "*the* efficient provision of public goods".

Efficient provision: Exercises

Let $C(G) = G$ and:

1.
$$U_A(x_A, G) = x_A + 2\log G$$
$$U_B(x_B, G) = x_B + \log G$$

2.
$$U_A(x_A, G) = x_A G^{\beta} \qquad (\beta > 0)$$
$$U_B(x_B, G) = x_B G^{\beta}$$

3.
$$U_A(x_A, G) = x_A G^2$$
$$U_B(x_B, G) = x_B G$$

Lindahl prices

One problem with the Samuelson solution is that it requires the planner to know people's preferences for the public good.

Lindahl (1919) pointed out that we could use prices to elicit this information just as in private goods markets – only with *tax prices* that differ among people.

Suppose that $C(G) = G$ and consumers have *quasi-linear preferences* $U_h(x_h, G) = x_h + V_h(G)$.

The Samuelson conditions are satisfied and the budget is balanced by charging each consumer a *tax price* t_h such that:

$$V_h'(G^*) = t_h \qquad \text{(all } h\text{)}$$

$$\sum_h t_h = 1$$

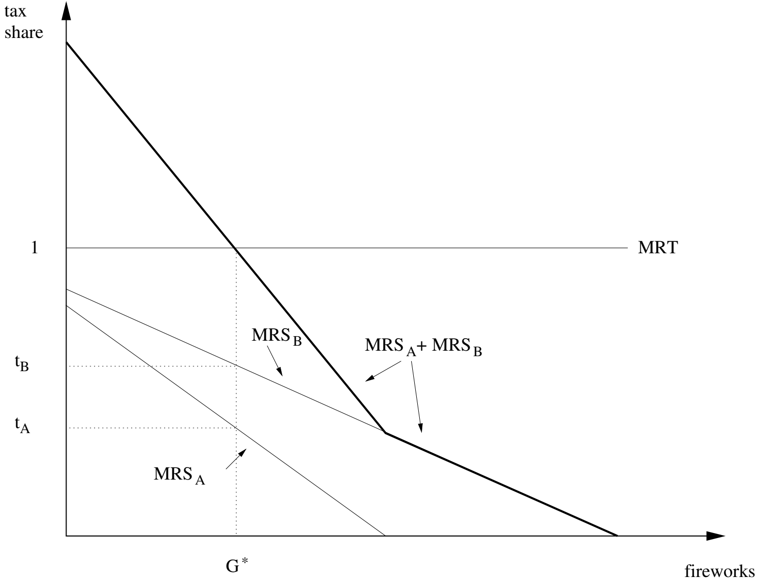


Figure: Lindahl equilibrium

Lindahl prices and efficiency

Note that:

- Efficient quantity is at intersection of cost curve with *vertical* summation of demand curves (compare private goods).
- At Lindahl prices (t_A, t_B), A and B unanimously agree that G^* is best.
- To achieve equilibrium, planner could announce any tax shares summing to one, elicit demands, and adjust them until there is unanimous agreement on G.
- Lindahl equilibrium is a *Pareto improvement* over non-provision – Lindahl prices act as benefit taxes.

Note that there is a *preference revelation problem*: truthtelling under Lindahl pricing is not *incentive compatible*.