Lecture 21: Public-sector pricing

Economics 336

Introduction

Many things government provides are or could be sold to the public – but they are not pure private goods:

- Excludable public goods are non-rival but could be sold: e.g. highways, computer software
- Natural monopolies are private goods where fixed costs are high enough to make private-sector competition infeasible: e.g. public transit, home telephone

Questions:

- How should these things be priced and provided?
- How do we know if they are socially valuable?

Natural monopoly

A simple example: N identical consumers demand q rides on public transit. Value of q rides is $s(q)$ in dollars. Marginal willingness to pay for qth ride is $P(q) = s'(q)$.

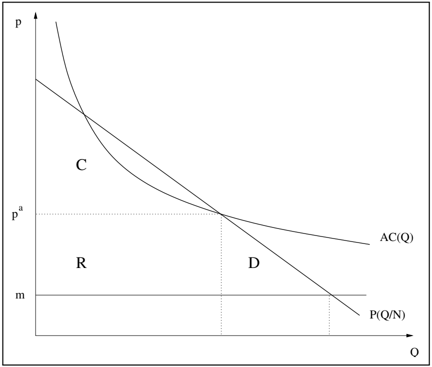
Fixed (capital) cost of transit is K. Each ride taken has marginal cost m. If N riders take $Q = Nq$ total rides, average cost of a ride is

$$AC(Q) = \frac{K}{Q} + m$$

Assume K is large relative to mQ: a *natural monopoly*. (Why?)

Questions: How many rides should people take, for what price? Should public transit exist?

Marginal-cost pricing



Maximizing social surplus:

$$\max_q Ns(q) - mNq - K$$

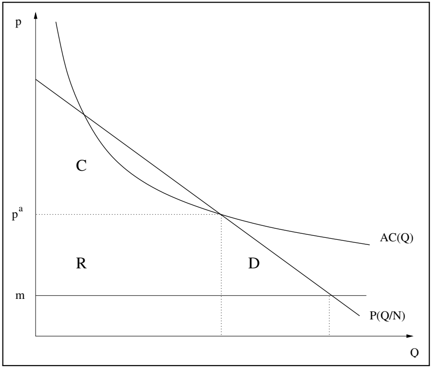
implies FOC

$$s'(q^*) = P(q^*) = m$$

Marginal cost pricing is "first-best".

How do we know if project is socially valuable?

Average-cost pricing



The project earns loss, because

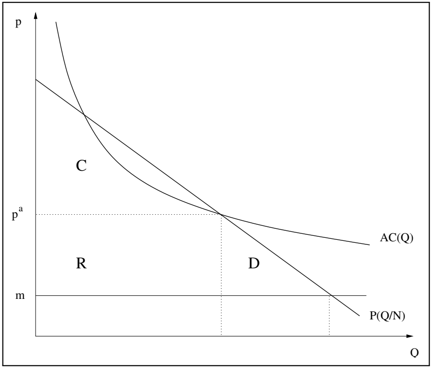
$$p = m < AC = m + K/Q$$

Therefore
government must subsidize
from general revenues.

It might be desirable
to require project to break even
(e.g. to "harden" public sector
agency's budget constraint).
Then set $p^a = AC(Q^a)$.

What is welfare loss of doing so?

Two-part pricing



Can the government do better and still cover costs? Consider a *two-part pricing* scheme: each consumer pays

- "connection fee" F;
- marginal price p per unit.

A two-part pricing system with $p = m$ and $F = K/N$ achieves the first-best outcome, while balancing the budget.

Will consumers be willing to pay the connection fee?

Yes, if

$$s(q^*) - mq^* - K/N > 0$$

i.e. if the project is socially efficient.

Summary

A system of two-part pricing allows the public utility to cover fixed costs while ensuring efficient usage. It is preferred to average-cost pricing, and possibly to marginal-cost pricing as well.

Is two-part pricing actually used in public transit systems?

Other examples of two-part pricing:

Problem: Consider consumption in two ways:

- *extensive margin*: who subscribes/doesn't
- *intensive margin*: quantity consumed by subscribers

While this system allows $p = MC$ and intensive margin efficiency, it discourages subscribers, reduces extensive margin efficiency

Second-degree price discrimination

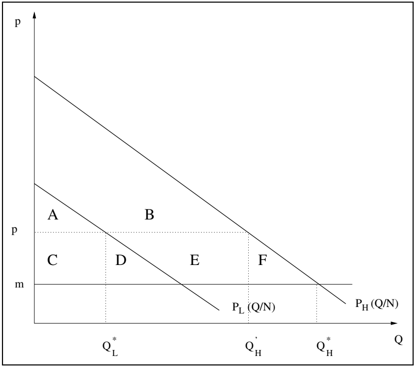
Price discrimination is the institution of offering different effective prices for consumers of different demands.

- First-degree price discrimination: Charge different consumers different prices for each unit sold, to expropriate all surplus.
- Second-degree price discrimination: Offer a *menu of contracts* to consumers, with lower unit prices charged to consumers who purchase larger quantities. Design the menu to expropriate maximum possible surplus from customers.

Price discrimination (especially when practiced by private firms) often seems unfair or anti-competitive. While it does increase profit, it also increases efficiency at extensive margin.

Is second-degree price discrimination used in public transit?

Example



Two consumer types, with willingness to pay $P_L(q) < P_H(q)$.

Design contracts to maximize profit, but keep L in the market, and keep H from choosing L's (cheaper) contract.

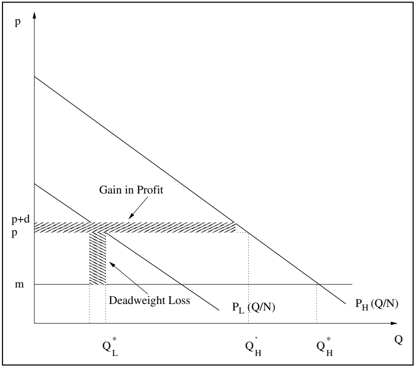
An optimal menu:

- H marginal price m, as before.
- L pays $p > m$ and connection fee A

Maximum connection fee for H is then:

which expropriates surplus to H for purchasing at lower price.

Optimal price discrimination



Optimal menu raises p until value of marginal profit gained from L and H equals deadweight loss in L's demand.

How could TTC increase efficiency of its two-part pricing system?

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Third-degree price discrimination

Third-degree price discrimination is the practice of charging different prices to different identifiable groups of consumers.

Third-degree price discrimination raises the likelihood of *cross-subsidization*: some customers pay more than average cost, while others pay less.

Examples:

- business vs. residential telephones
- downtown vs. suburban transit riders

Cross-subsidization may in fact be efficient: fixed costs should be paid by those who can afford to do so, without distorting their demand.

Example: There are two identifiable groups (business and residential). Government must set prices (no connection charge) to break even. To minimize deadweight loss, the optimal prices are inversely proportional to elasticity of demand:

$$\frac{p_i - m}{p_i} = \frac{a}{\epsilon_i}$$

where a is chosen to cover fixed costs. *The Ramsey rule: Inelastic demanders should pay more of the fixed cost.*

Cross-subsidization raises the possibility of inefficient *cream-skimming*: competitors go after only profitable customers, reducing efficiency. Examples?

Peak-load pricing

For many services, demand varies by time. Examples: roads and public transit systems, electricity, etc. How should prices respond?

Example: Public transit capacity

The capacity of a subway system is K passengers per hour. Capacity costs cK in capital. Operating costs are zero. Inverse demand for trips T is, at rush hour:

$$w_r(T) = A_r - T$$

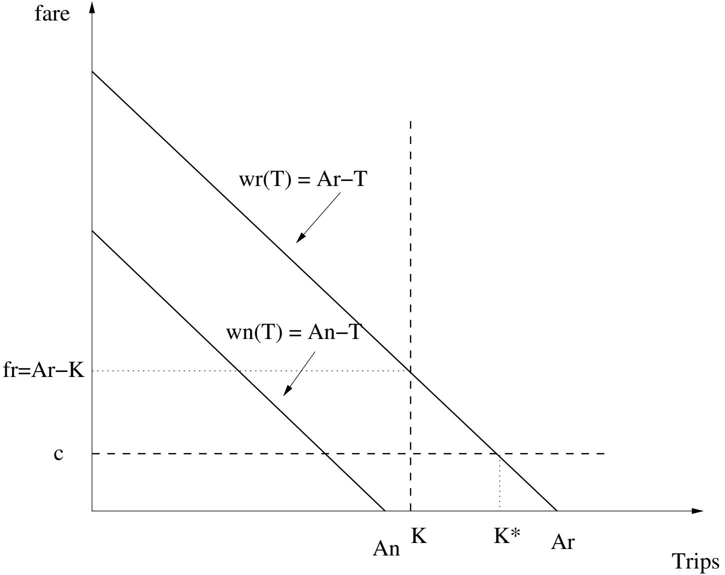
and at non-rush times

$$w_n(T) = A_n - T$$

where $n < r$.

What prices should be set? What capacity should be built? How should capital costs be allocated among users?

Peak-load pricing: Example



Peak-load pricing: Example

Suppose capacity K is such that $A_r > K > A_n$: excess demand only at rush hour.

- Set $f_n = 0$ outside rush hour.
- Set

$$f_r = w_r(K) = A_r - K$$

  so $T_r = K$ to ration demand at rush hour.

Choice of K: cost of serving one more consumer at rush hour is c; marginal social benefit is $w_r(K)$. So set K^* to

$$c = w_r(K^*) = A_r - K^*$$

implying $f_r(K^*) = c$. Revenues of the transit system:

$$R = f_r(K^*)T_r(K^*) + f_n T_n = cK^*$$

The budget exactly balances!

Peak-load pricing: Summary

Peak-load pricing serves two roles:

- high peak prices ration demand at times when capacity is insufficient to satisfy everyone, more efficiently than queueing;
- since new capacity must be built only to satisfy peak demand, peak-load pricing is *benefit taxation*: those who benefit from new capacity must pay for it.

Peak-load pricing is used occasionally (examples?) but technological improvements make it more likely in future.