Chapter 8: Public Enterprise Pricing Rules
• Governments sometimes choose to produce goods and services and charge a price for those goods and services.

• Pricing decisions and investment decisions sometimes go hand in hand.
  – For example, government might want to evaluate whether to build a dam that produces electricity. The benefits and costs of the project will depend on how the electricity is priced. If this is not priced optimally then can get a misstatement in NPV and can also get output that might not be socially optimal level (either larger or smaller).

• In competitive economy with no externalities or distortions welfare is maximized if good or service is priced at marginal cost, maximizes social welfare. (Any other price would cause a welfare loss)
• Sometimes though it’s hard to use marginal cost price or the use of marginal cost pricing leads to other problems.

• We’ll primarily consider a few alternative pricing strategies/approaches:
  – Natural Monopoly
  – Prefect Price Discrimination
  – Two-part tariffs
  – Cyclical Demand
Natural Monopoly

- Public Utilities are natural monopolies that are characterized by significant economies of scale.
- Costs of project in a natural monopoly fall as output is increased. This means that the MC to society & the firm must be below the AC.
- Unregulated monopoly will produce at the point where MR = MC (point E) and will result in market price $P_M$ and output $Q_M$ profit of $P_MBAC$. 

![Figure 8.1: Natural Monopoly](image-url)
Natural Monopoly

- Society suffers a welfare loss, since MB to society of $Q_M$ is greater than social cost at distance between $E$ and $Q$–axis. Units that would benefit society are not produced, resulting in the welfare loss $BEF$.

- Social optimum level of output is $Q_s$ where $D = MC$, marginal benefits to society equal marginal cost to society of producing this last unit.
• How does the gov’t eliminate the welfare loss?
  – The government can either run monopolist itself or regulate the monopoly.
  – The gov’t would have two options at its disposal for regulating the monopoly, i.e., MC (marginal cost) pricing or AC (average cost) pricing.
Natural Monopoly: MC Pricing

- Marginal Cost Pricing
  - to obtain efficient outcome set $P = MC$
  - The firm will incur a loss because $P < AC$ since $MC < AC$ (HGFP$_s$)
  - so gov’t would have to pay a subsidy to offset the loss, HGFP$_s$
Natural Monopoly: AC Pricing

• Average Cost Pricing
  – set \( P = AC \), results in output \( Q_o \) sold at \( P_o \)
  – no financial loss, but there is a welfare loss because the units between \( Q_o \) & \( Q_s \) which are not produced marginal social benefits exceed marginal social cost
  – welfare loss \( KFJ \)
Regulating a Natural Monopoly

• choice between MC pricing & AC pricing requires a tradeoff between welfare and financial loss.

• If MC pricing is chosen must scale project to the size at which it will produce $Q_S$ at least cost.

• If AC pricing is used fewer resources will be required.
Monopoly: Perfect Price Discrimination

- Another pricing method available to monopolist is to price discriminate perfectly, by charging each consumer a different price, i.e. the most they would pay for each unit of the good or service.
- However, to do this the monopolist must be able to distinguish individuals on the basis of willingness to pay the resale of the good is not possible or preventable.
- Numerical example on pages 167-168 works through the points
  - NOTE: Society incurs no welfare loss when the monopolist can engage in perfect price discrimination because the firm produces the social optimal output. Firm extracts all the consumers’ surplus, but only transfers benefits from consumers to firms.
- Loeb-Magat showed that this efficiency property of price discrimination can be used to regulate a monopoly firm that cannot price discriminate, by using a subsidy scheme of the following form: Subsidy = (P₁ + P₂ + P₃ + ... + Pₖ) – Kₚₖ and letting the monopolist produce K units at price Pₖ.
Monopoly: Perfect Price Discrimination

• Can also tax the monopolist who is earning positive profits with a proportional tax on profits or lump tax or a licensing fee.
  – Need a lump sum sort of tax because don’t want to distort decisions.
• Loeb-Magat subsidy scheme creates an incentive for the monopolist to expand output to the social optimum level, but the lump sum tax that is combined with it doesn’t cause the firm to change output from that level.
• Loeb-Magat subsidy and marginal cost price regulation both yield the same output & eliminate the welfare loss from the monopoly.
• Loeb–Magat scheme is preferable because only requires knowledge of demand conditions; but marginal cost pricing requires knowledge of demand & supply conditions.
Two-Part Tariffs

• Sometimes referred to as Disney land problems
  – e.g., how to price an amusement theme park visit.
  – The theme park provides rides at a constant marginal cost of C dollars per ride (R)
    • assumes income elasticity for rides is zero.

• This pricing approach consists of two components, a fixed fee + an additional charge;
Two-Part Tariff: Homogenous Demand Case

• For equilibrium (D=MC) in the diagram the consumers surplus is ABC

• Consumers surplus is the most the person would pay for C rides at a price of C dollars each.
  – A profit maximizing monopolist would charge ABC as an admission fee.
  – The revenue from rides will be OCBR*, which is equal to the cost of producing the rides.
Two-Part Tariff: Homogenous Demand Case

- If monopolist were to charge a price greater than the marginal cost, say price $P_H$, the most he’ll be able to charge for admission is $AE \ P_H$
  - as the price of the ride increases the consumers surplus and maximum admission fee the individual is willing to pay decreases. If the monopolist charged this fee then his profits are given by $AE \ P_H$ from the admission fee and $P_H \ EO \ R_H – CF \ R_H \ O$ from the rides.
  - Monopolists profits will be $ABC – EBF < profits from charging ABC admission fee and C dollars per ride.
Two-Part Tariff: Homogenous Demand Case

- If the monopolist charges a lower price per ride, $P_L$, it can charge a higher admission charge $AG$ but does so with a loss on the rides revenue $O P_L G$ $R_L$ cost $O C H R_L$, with a total profit $ABC - BHG$.
• Monopolist maximizes profits from an individual by pricing rides at marginal cost and charging an admission fee equal to their consumers surplus at that price

• Charging MC for rides means don’t get over or under consumption of rides if \( P > MC \) get under consumption if \( P < MC \) get over consumption

• with all consumers identical maximizing profits with this pricing scheme.
Two-Part Tariff: Heterogenous Demand Case

- without price discrimination, the monopolist has two options to maximize profits:
  - (1) charge an admission fee of CXY and C dollars per ride and capture all of consumers surplus from D2 but only part of that from D1
  - (2) Charge admission fee of CZW and C dollars per ride. Type 2 people don’t go, but get all of surplus from D1

- Option 2 makes sense when CZW > 2 CXY
Two-Part Tariff: Heterogenous Demand Case

• From welfare perspective option (2) is inferior to that in (1) because type 2 consumers don’t buy any rides, earn no surplus and monopolist gets no profits from them.

• Basic Results:
  – (1) a price not equal to MC can generate a welfare loss.
  – (2) An entrance fee that results in any individual not entering the park results in a welfare loss.
Peak Load Pricing (or Cyclical Pricing)

• Peak load pricing arises in the following setting:
  – there are times of peak demand and times of off-peak demand but the capacity of a facility cannot be adjusted instantaneously to ensure that price is equal to marginal cost also not possible to store production in off-peak periods for use in peak periods. e.g., electricity, long distance call.

• The goal is to minimize excess capacity & maximize social welfare, which require that all consumers pay the marginal cost of producing whatever amount they consume.

• Consequently, prices must be used to equate marginal benefits and costs in all parts of demand cycle
Peak Load Pricing (or Cyclical Pricing)

• If idle capacity exists in off peak periods, off-peak users derive no benefit if the capacity is expand. On the other hand, peak period users will benefit if capacity is increased and efficiency requires the price they pay reflect this.

• Efficient pricing requires that off-peak users pay a lower price than peak users. Examples might include, rates for long distance calls at midnight are lower than those at noon, prices for electricity are higher during business hours then in the middle of the night
Peak Load Pricing

- off-peak lasts $W_2$ of the cycle peak period lasts for $W_1$ of cycle so that $W_1 + W_2 = 1$
- $D_1$ demand during peak period & $D_2$ during off-peak
- The cost of increasing capacity an extra unit during the cycle is $\beta$ and extra variable cost of one more unit $b$.

![Diagram of Peak-load Pricing](image)
Peak Load Pricing

- Total LRMC is constant \((b + \beta)\)
- SRMC is constant up to a particular point after which it is impossible to produce more without expanding output, kinks at that point.
- If off-peak, consumers \(P_2\), equate MB with MC so \(P_2 = b\)
- During peak, cost of producing one additional unit is \(\beta\), which is required to expand capacity; if the peak period lasts through the whole cycle then \(P_1\) would measure the peak users marginal benefit but since \(W_1 < 1\) their marginal benefit is \(W_1 P_1\), marginal cost of production is \(W_1 b + \beta\), where MB = MC; so that
  - \(W_1 P_1 = W_1 b + \beta\)
Peak Load Pricing

• In equilibrium, we will have MB=MC &
  \[ W_1 P_1 = W_1 b + \beta \] so that \[ P_1 = b + \frac{\beta}{W_1} \]

• The optimal pricing rule will have:
  – \[ P_2 = b \]
  – \[ P_1 = b + \frac{\beta}{W_1} \]

• Thus you would charge different prices in different parts of the cycle
Peak Load Pricing: Welfare Implications

• Suppose you charge all consumers the same price, \( p^* \) instead of \( P_1 \) & \( P_2 \)

• At the lower price of \( p^* \) peak users will want to consume \( Q_3 \) but the facility can only produce \( Q_1 \), so their consumption remains at \( Q_1 \) but they are better off because they pay a lower price.

• no implication for welfare because its just a transfer from firms to peak users.
Peak Load Pricing: Welfare Implications

• For the off peak users, they would consume less at $p^*$, quantity falls from $Q_2$ to $Q_4$.
• They will be worse off:
• Loss of benefits: $Q_4 AB Q_2$
• Resource Savings: $Q_4 CB Q_2$
• Welfare loss: $ABC$
• Adjusting for fact that off-peak consumption is $W_2$ of total welfare loss is $W_2 * ABC$
Peak Load Pricing

• With peak load pricing consumers at every stage of the demand cycle pay the marginal cost of their consumption.

• If price uniformly across the cycle (i.e., charge the same price at all points in the cycle) you get a welfare loss

• Also results in under producing facility
Second Best Pricing

• Consider a distorted market where:
  – $MC_S$ – marginal cost of society
  – $MC_P$ – marginal cost to producer
  – with $MC_S > MC_P$

• Have an externality on supply side, but no externality on demand side

• In a competitive market have equilibrium where $MB_P = MC_P$
Second Best Pricing

• Profit maximizing firm expands production as long as $P>M$ and utility maximizing households demand more as long as $MB_p > P$

• In competitive equilibrium $MB_p = MC_p = P$ \((Q_C, P_C)\)

• with a distortion, the competitive equilibrium not socially optimal

• To maximize welfare only output where $MB_s > MC_s$ should be produced, with the socially optimum point \((Q_O, P_O)\)
Second Best Pricing

• correcting distortion
  – tax equal to distance between X & Z shifts $MC_p$ up to $MC_s$
  – eliminates welfare loss from competitive outcomes
• Not always possible to use corrective tax alternatives.
  – Toll booths on roads, creates traffic congestion which might make some drivers switch transportation methods
  – Subsidizing other forms of transportation
• Trade welfare loss in market where taxes and subsides can be levied for a welfare gain in a related distorted market that cannot be controlled in a direct means is second best pricing.
• 2\textsuperscript{nd} best because can’t eliminate all the welfare loss.
From Pricing to Project Selection

• Pricing rules are important in the context of cost benefit analysis because they determine what the output of a public project should be in a given period.

• The goal is to build a project at lowest cost and also make sure capacity will be optimal for all periods.

• Facility of optimal size yields a higher net present value than a larger or smaller facility.
From Pricing to Project Selection

• Complications:
  – demand might change overtime
  – population growth/ decline
  – changes in average income
  – changes in age structure of population

• You should be able to adjust scale of project to account for this during economic life of project
  – This is easy in some cases (public transit) hard in others (hydroelectric dam)
From Pricing to Project Selection

• Choose optimal size facility pick alternative that yields highest present value.
  – However, even this can change over time.
    • For example, in the 1970s it was generally thought to get scale economies you need large generating facilities; today the consensus is that you can get scale economies in much smaller facilities.
    • Consequence of this, Ontario invested in nuclear power plants and cost structure is not as low as initially thought (Ontario has above average prices for electricity in Canada).
From Pricing to Project Selection

- Townley also suggests that you shouldn’t make hard or fast choices based on size, e.g. if school is built in an area where population declines and grows older, the facility will be too large in a few years. => build multipurpose spaces with other uses, i.e., a more flexible space that can be put to alternative uses.

- Flexibility is key when it comes to size.