What Economics Means for Regulators and What You Need to Know
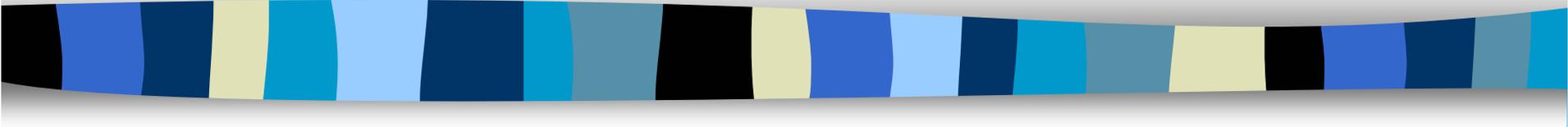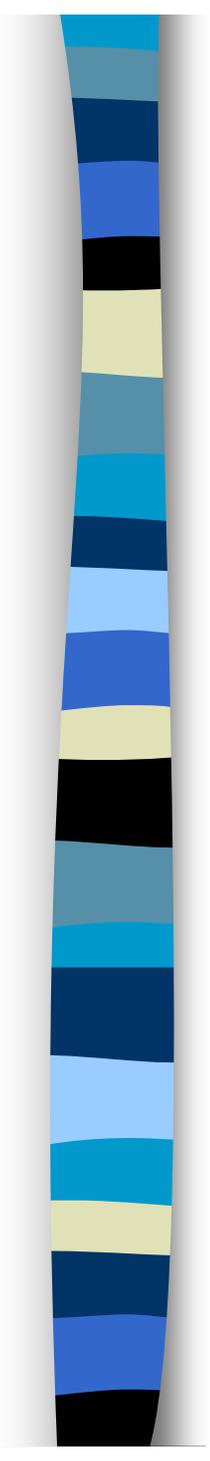
Ken Boyer

Professor of Economics

Michigan State University
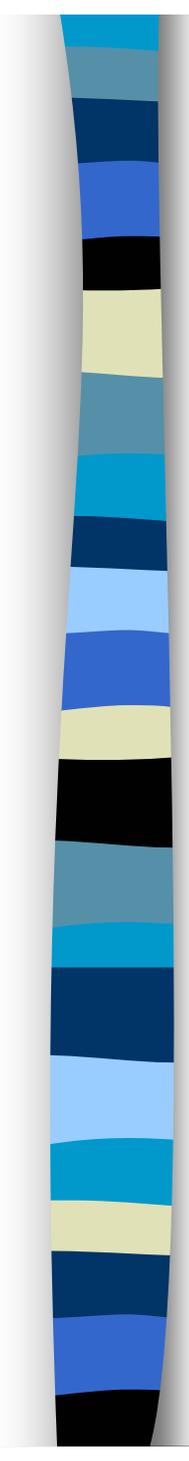
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Introduction

- A review of principle of economics that you may have forgotten

  - Costs

  - The concept of efficiency and subsidy free prices

  - What difference network effects make

  - The rationale for regulation

The CALLS Decision

- Eliminates Pre-subscribed Inter-exchange Carrier Charge.

- Reduced switched access usage rates.

- Removal of $650 million in implicit universal service support from access charges.

In What Sense is This Good Economics?

- FCC says: "to the extent possible, costs of interstate access should be recovered in the same way that they are incurred. This approach is consistent with principles of cost-causation and promotes economic efficiency. Thus, non-traffic-sensitive costs should be recovered through fixed, flat-rated fees. Similarly, traffic-sensitive costs should be recovered through corresponding per-minute access rates."

In What Sense is This Good Economics? (continued)

- "The Commission's rules, however, are not fully consistent with this goal. In particular, because the Commission has taken a cautious approach in addressing affordability concerns, it has taken measured steps toward this goal by limiting the amount of the allocated interstate cost of a local loop that is assessed directly on residential and business customers as a flat monthly charge."

In What Sense is This Good Economics? (continued)

- "By allowing LECs to recover non-traffic-sensitive (flat) costs through traffic sensitive (per minute) rates, high-volume users bear a greater share of the non-traffic-sensitive costs than low-volume users, thus creating an implicit support flow from high-volume users to low-volume users. Furthermore, the practice of averaging rates over large geographic areas, for both intrastate and interstate services, results in subscribers in low-cost areas subsidizing the rates of subscribers in higher cost areas."

In What Sense is This Good Economics? (continued)

- "Congress concluded that the support provided by these mechanisms 'should be explicit and sufficient to achieve the purposes' of section 254, which include the purpose that all Americans should have access to telecommunications services at affordable and reasonably comparable rates. The subsidies implicit in geographic averaging must be reduced if competition is to develop outside of urban areas; but these subsidies can never be entirely eliminated, without pricing service on a line-by-line-by-line basis. Affordability concerns deter us from allowing end-user charges in higher cost areas to increase to the point where they recover the cost of providing service in those areas, whether cost is determined on a forward-looking or historic basis."
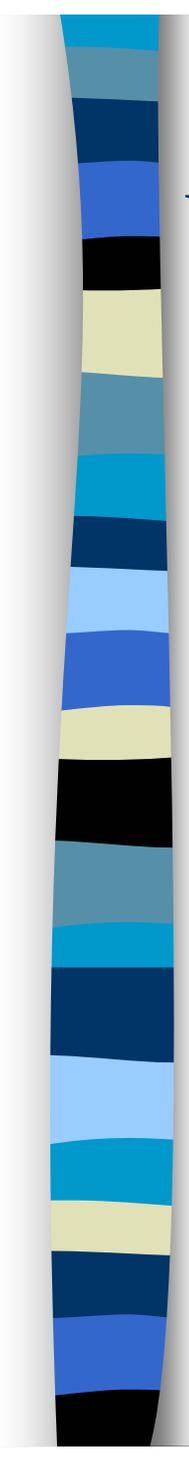
We Will Deal With These Issues

- How to measure cost.

- Why cost-based pricing is desirable.

- The sense in which competition will lead to cost-based pricing. (Did the FCC get the economics right?).

- How does economics deal with equity issues implicit in universal service calculations?

  – The economics of cross-subsidies.
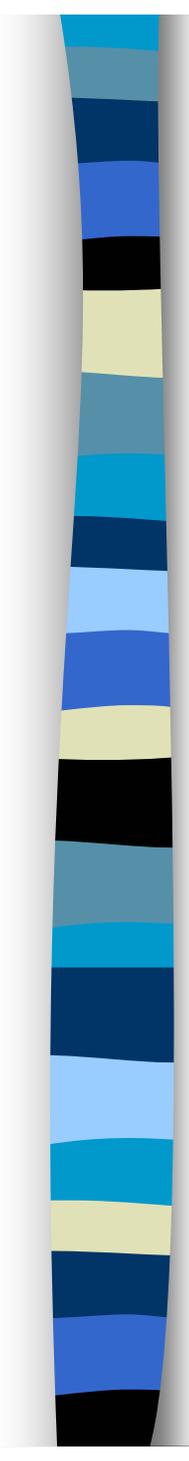
Measures of Economic Costs

- Economic costs versus expenditures.

  - An economic cost is a measure of the value of what you give up in order to do something.

    - Measured in dollars.

    - May involve much more (or much less) than simple dollars expended.

  - EG: what is the cost of a year's college education.
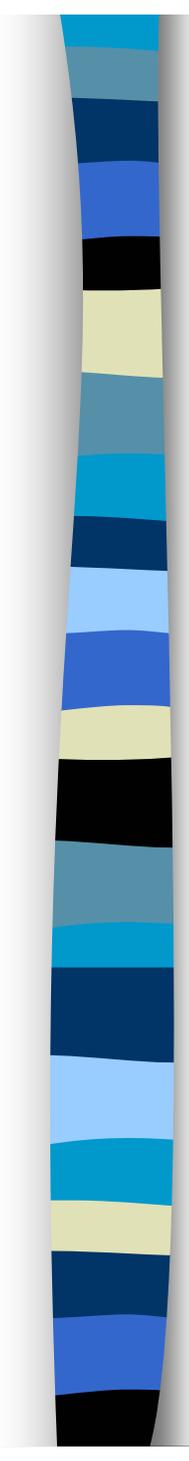
Cost categories

- Total cost

  - Variable cost

  - Fixed costs

- Average total cost

  - Average variable cost

  - Average fixed cost

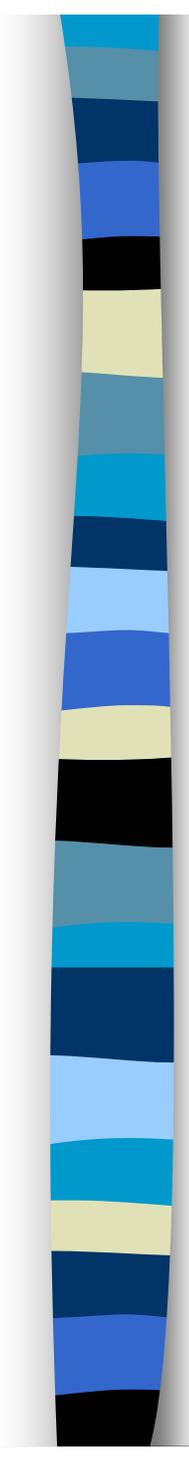- Marginal cost

- Incremental cost

- Average incremental cost
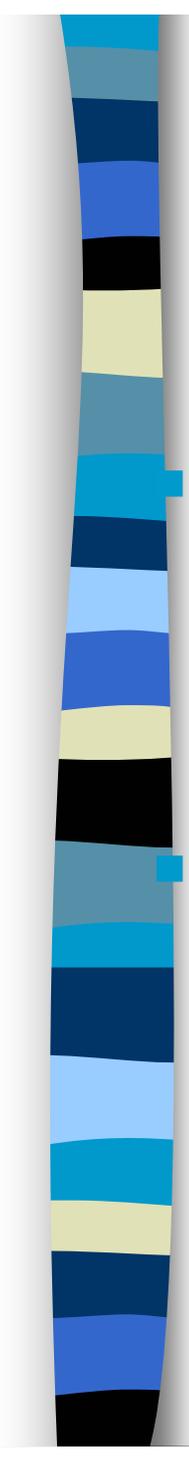
Fixed and Sunk costs

- A fixed cost is one that does not vary <u>with the level of output</u>.

  - Whether the cost is constant or predictable over a year is not the issue.

- A sunk cost is an investment that can not be recovered if a project is shut down and equipment sold.

 - Sunk cost = depreciated original cost-salvage cost.

The philosophical foundation of cost curves

■ Costs are not (necessarily) related to expenditures.

■ Rather, costs are derived from.

1. The production function and.

2. Factor costs.

   (The costs of purchasing inputs).

A Numerical Example

- Calculating fixed costs

- Calculating variable costs from production function and factor costs

- Calculation of average fixed, variable, and total costs

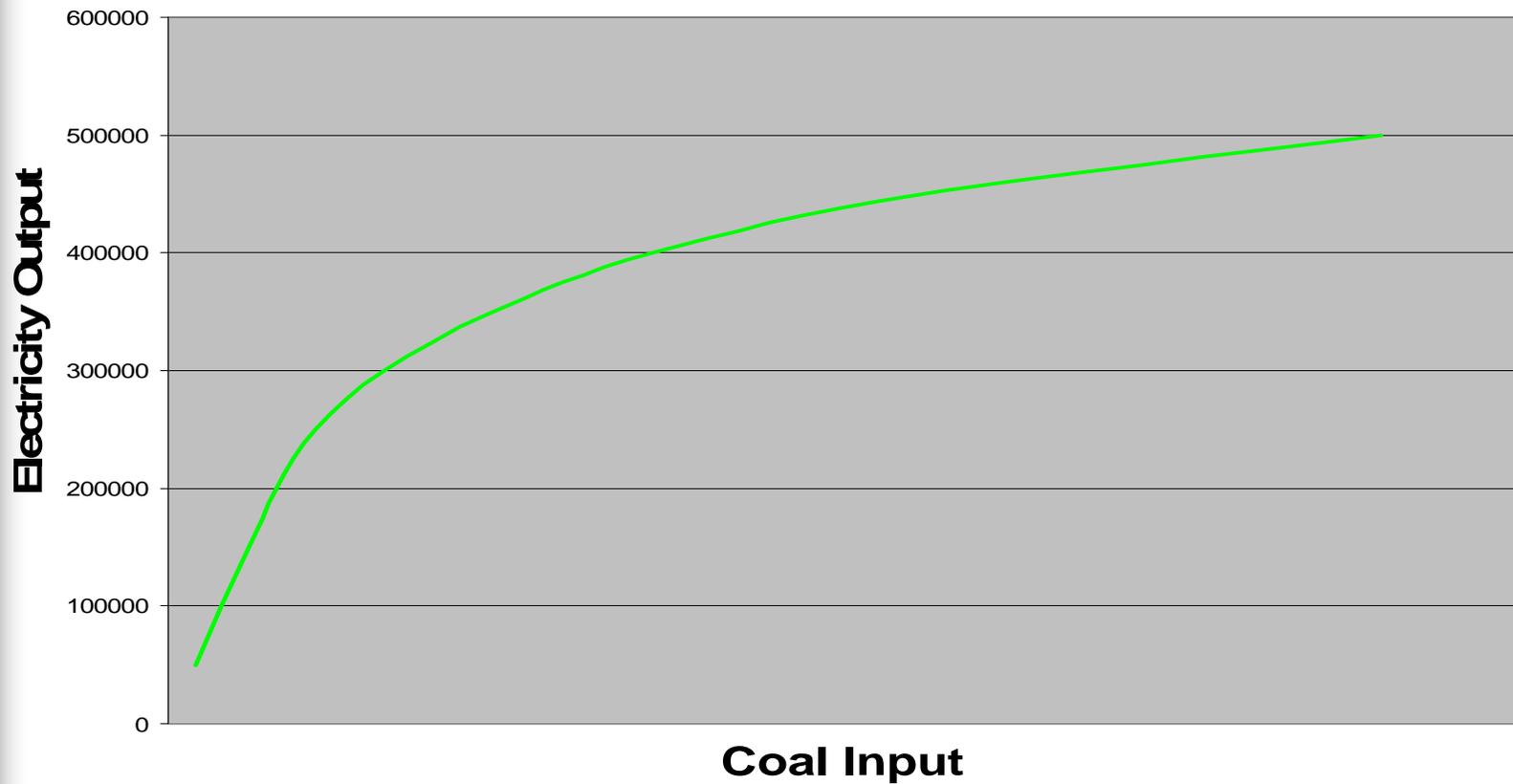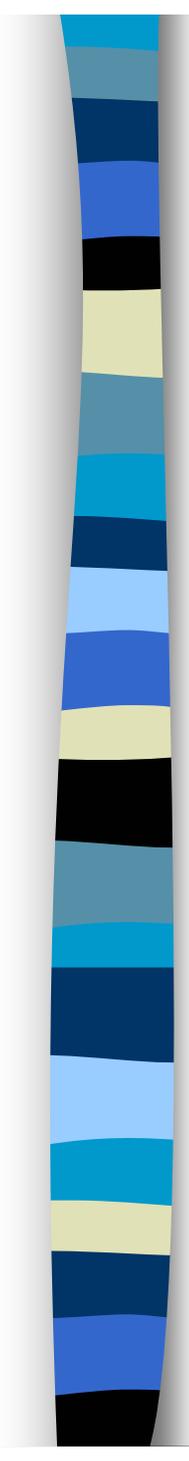- Graphing marginal cost, average variable cost, and average total cost
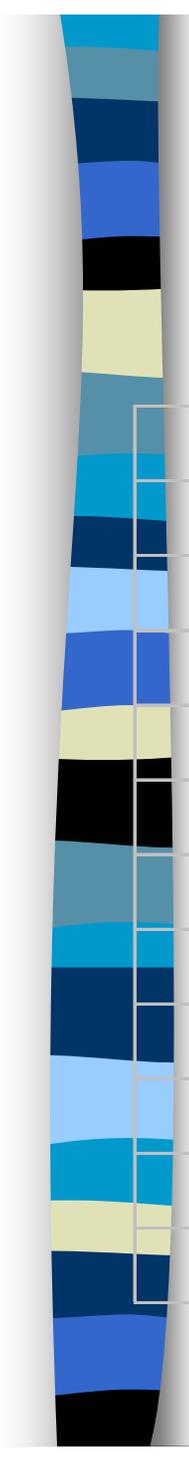
The production function

KWT/Hr	Tons of Coal Required
0	0
50000	200
100000	400
150000	600
200000	800
250000	1100
300000	1600
350000	2400
400000	3600
450000	5600
500000	9000

Graphing the production function
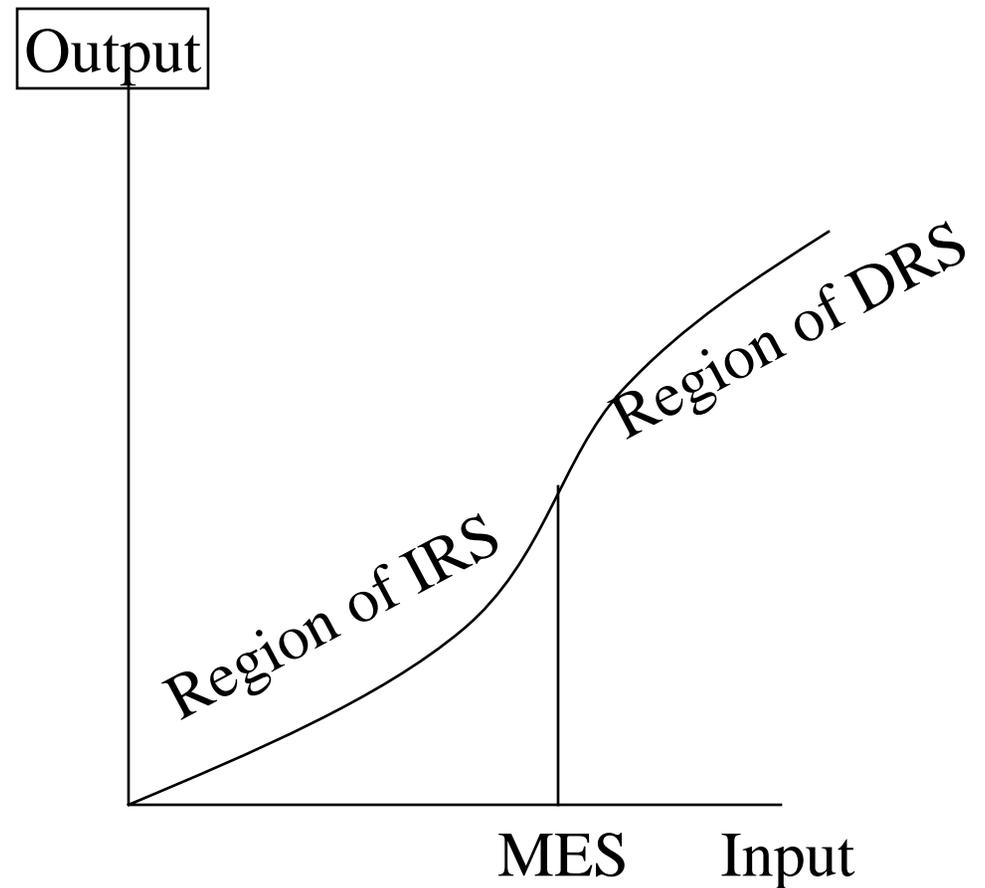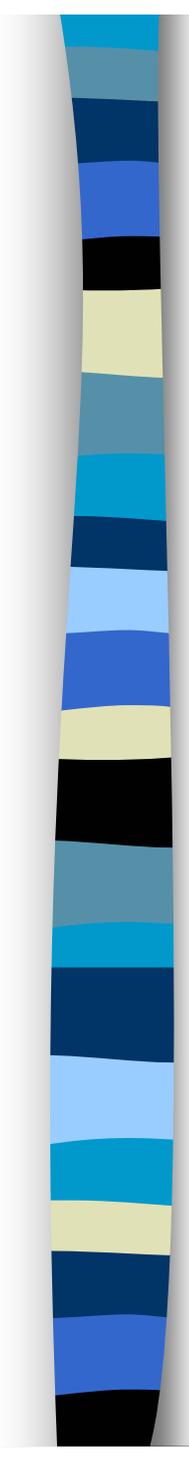
Production Function

Short Run and Long Run

- The production seen on the previous slide is a short run relationship.

- In the short run there are capacity constraints.

  - It is capacity constraints that cause the curve to flatten out.

- Without capacity constraints, would the curve never flatten out?

  - This is the question of economies of scale

  - If it never flattens, there are constant returns to scale.

Minimum Efficient Scale

- If the technological processes put a penalty on very small scales of operation, the long run production function may hook upward

Electricity Economics

- In electrical generation, MES has been falling for the last 25 years.

- Is the era of the large power station near an end?

- The long run production function has been straightening out.

- Encourages small scale production to economize on costs of transportation (transmission and distribution.)
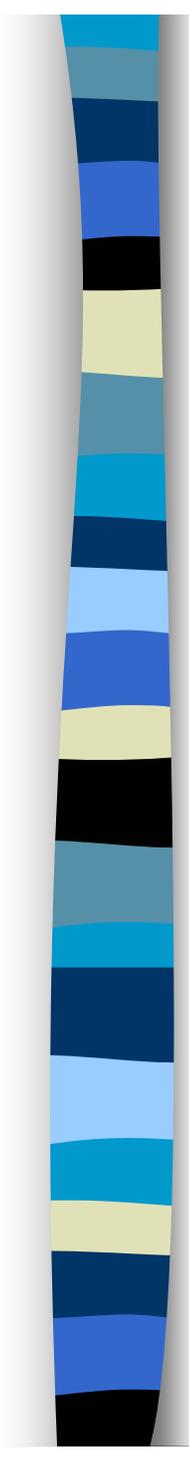
Factor Costs

Setting up a Numerical Example of a Cost Function	
Price per ton of coal:	$10.00
Price of a new power plant:	$1,000,000,000.00
Percent financed by bonds:	50%
Going interest rate:	10%
Labor required/hr	100
Wage of Labor per hour	$20.00
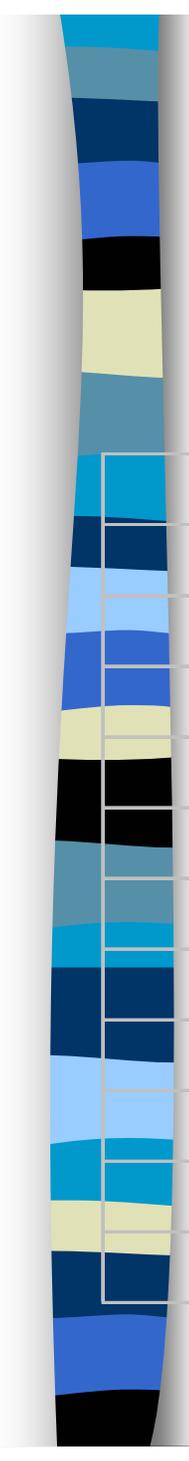
Variable Cost Calculation

Output	Fuel Cost
0	$0.00
50000	$2,000.00
100000	$4,000.00
150000	$6,000.00
200000	$8,000.00
250000	$11,000.00
300000	$16,000.00
350000	$24,000.00
400000	$36,000.00
450000	$56,000.00
500000	$90,000.00
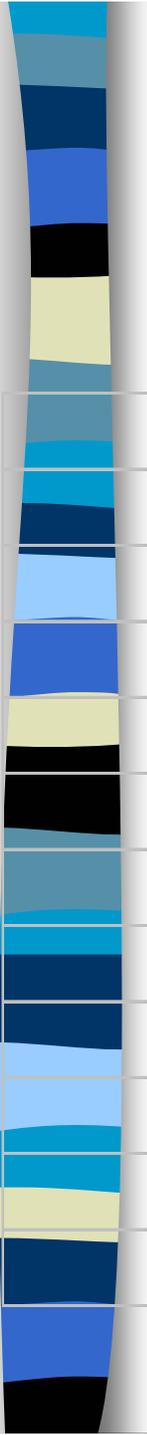
Fixed Cost Calculation

Output	Labor	Debt Service	Implicit Cap. Costs	Total
0	$2,000	$5,708	$5,708	$13,416
50000	$2,000	$5,708	$5,708	$13,416
100000	$2,000	$5,708	$5,708	$13,416
150000	$2,000	$5,708	$5,708	$13,416
200000	$2,000	$5,708	$5,708	$13,416
250000	$2,000	$5,708	$5,708	$13,416
300000	$2,000	$5,708	$5,708	$13,416
350000	$2,000	$5,708	$5,708	$13,416
400000	$2,000	$5,708	$5,708	$13,416
450000	$2,000	$5,708	$5,708	$13,416
500000	$2,000	$5,708	$5,708	$13,416
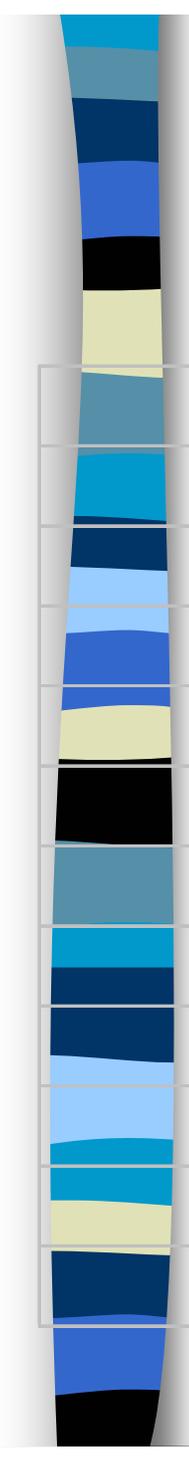
Total Cost Calculation

Output	Variable Cost	Fixed Cost	Total Cost
0	$0.00	$13,415.53	$13,415.53
50000	$2,000.00	$13,415.53	$15,415.53
100000	$4,000.00	$13,415.53	$17,415.53
150000	$6,000.00	$13,415.53	$19,415.53
200000	$8,000.00	$13,415.53	$21,415.53
250000	$11,000.00	$13,415.53	$24,415.53
300000	$16,000.00	$13,415.53	$29,415.53
350000	$24,000.00	$13,415.53	$37,415.53
400000	$36,000.00	$13,415.53	$49,415.53
450000	$56,000.00	$13,415.53	$69,415.53
500000	$90,000.00	$13,415.53	$103,415.53

Graphing total cost and its parts

Fixed, Variable, and Total Cost
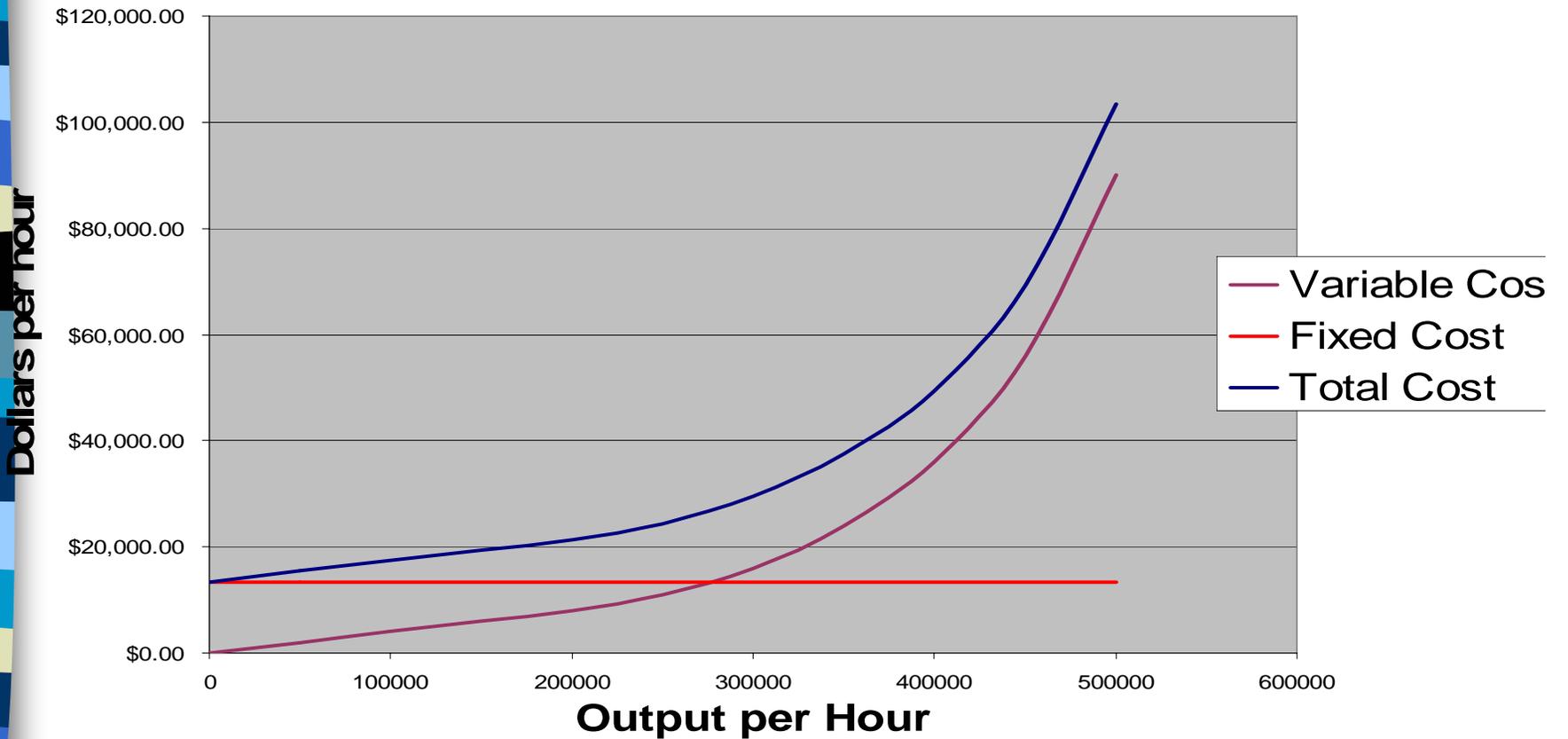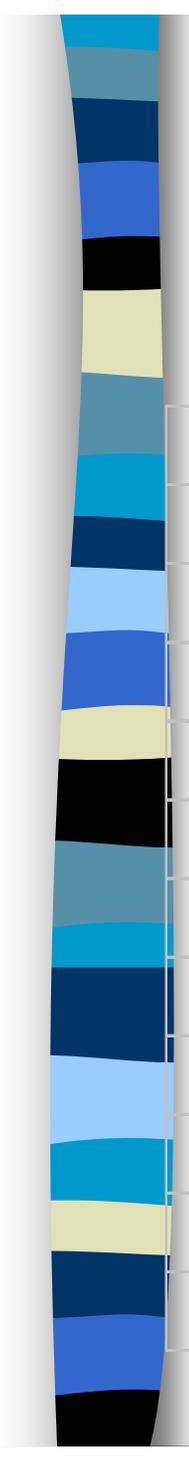
Unit Cost Calculations

Output	Av. Var. Cost	Av Fixed Cost	Av Total Cost
0			
50000	$0.040	$0.268	$0.308
100000	$0.040	$0.134	$0.174
150000	$0.040	$0.089	$0.129
200000	$0.040	$0.067	$0.107
250000	$0.044	$0.054	$0.098
300000	$0.053	$0.045	$0.098
350000	$0.069	$0.038	$0.107
400000	$0.090	$0.034	$0.124
450000	$0.124	$0.030	$0.154
500000	$0.180	$0.027	$0.207
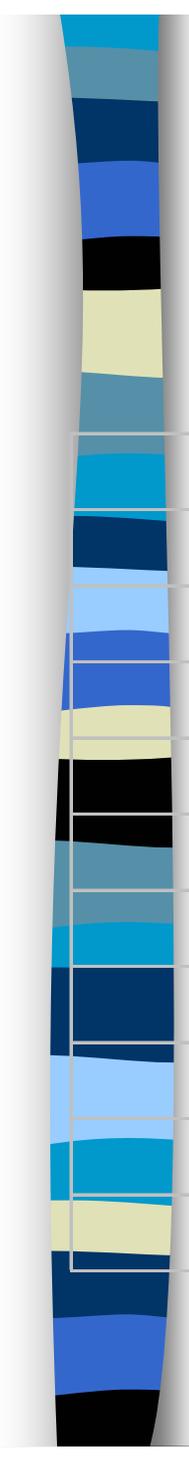
Marginal Cost Calculations

Output	Marginal Cost	Av. Var. Cost	Av. Total Cost
25000	$0.040	$0.040	$0.577
75000	$0.040	$0.040	$0.241
125000	$0.040	$0.040	$0.152
175000	$0.040	$0.040	$0.118
225000	$0.060	$0.042	$0.102
275000	$0.100	$0.049	$0.098
325000	$0.160	$0.061	$0.102
375000	$0.240	$0.079	$0.115
425000	$0.400	$0.107	$0.139
475000	$0.680	$0.152	$0.181

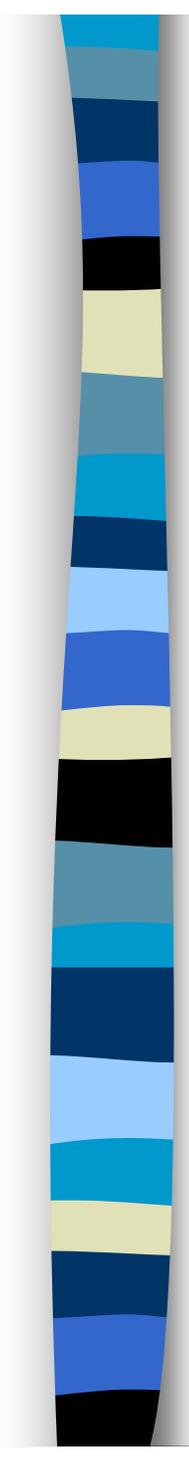# Classic economic cost curves

Marginal and Average Costs
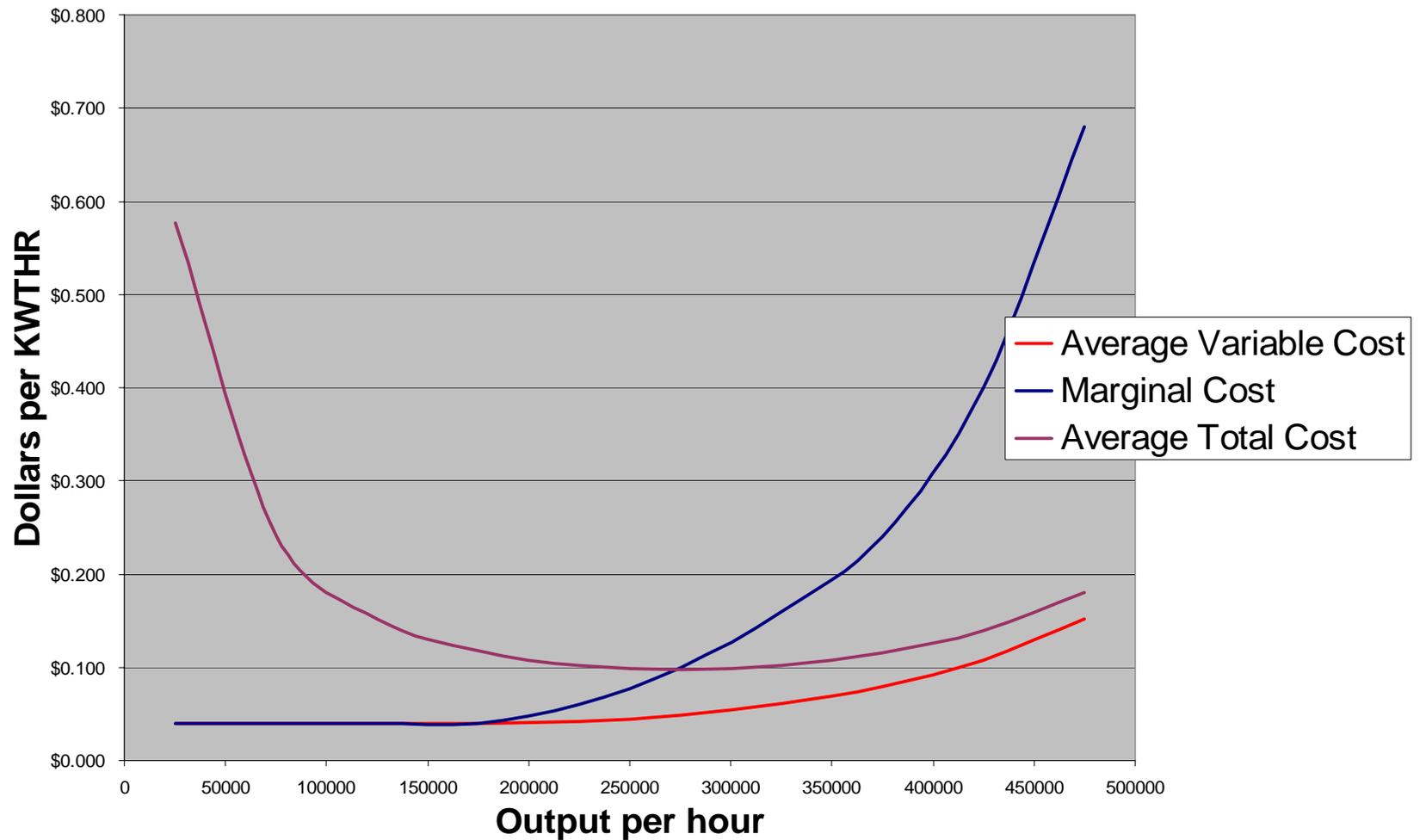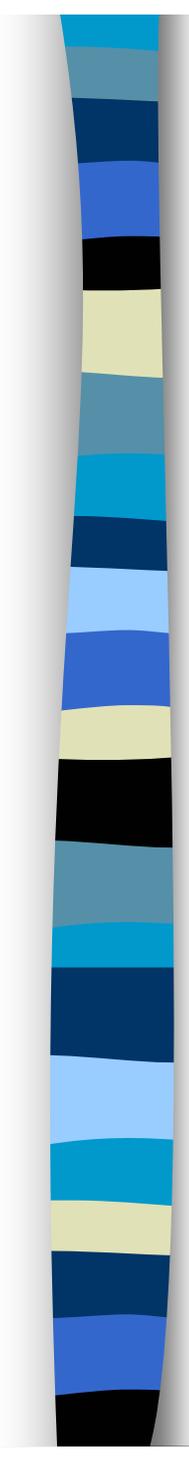
The Shape of Cost Curves

- Spreading overhead costs

- The law of diminishing returns and its effect on average variable and marginal costs

- The classic U shape of the average total cost curve

  - Derived from presence of fixed costs

  - And the law of diminishing returns

What changes the cost curves?

- Technological improvement.

- The cost of coal.

- The wage of labor.

- The cost of capital.

  – If the curves measure opportunity cost, the issue of how much cost is imbedded is irrelevant.
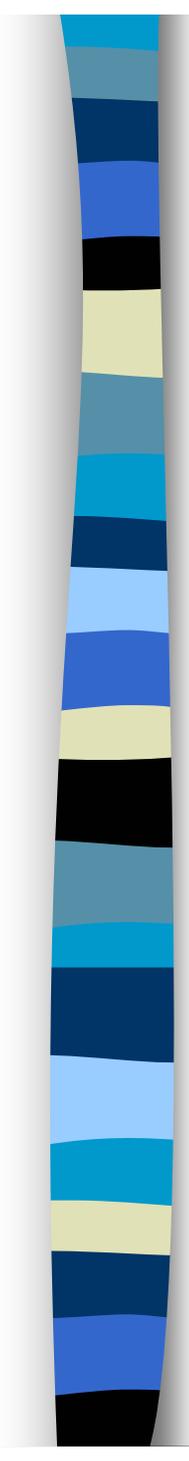
Why is cost calculation controversial?

- Making a gesture towards financial costs.

    - Embedded costs are real to those who have to pay them.

- Network issues.

    - Facilities are used to make more than one type of product.

    - Raises the issue of "cost allocation."

    - If network access charges are wrong, uneconomic entry can be encouraged or competitive forces thwarted.
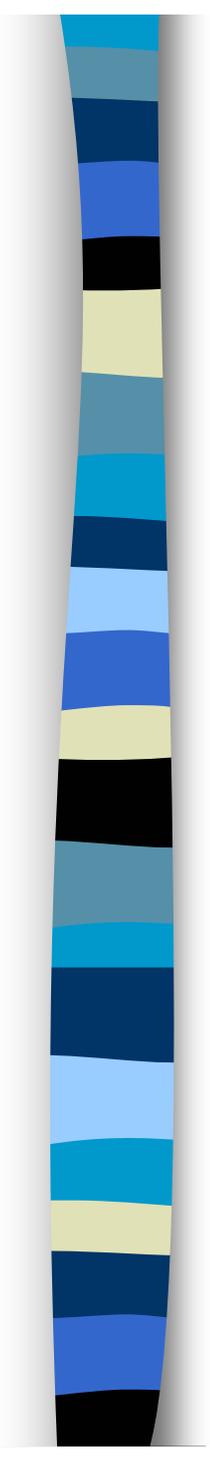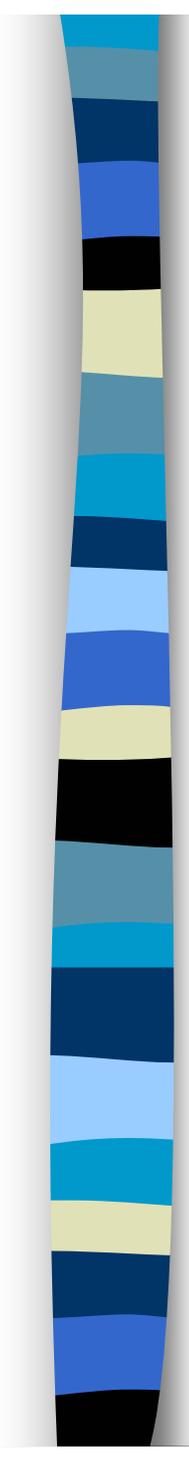
Network Costs

- The concept of network externalities.

  - Production or consumption in one part of a network affects users in other parts.

- Joint costs and common costs.

- Subadditivity and economies of scope.

  - Costs are subadditive if costs can not be lowered by dividing output vector.

  - There are economies of scope if it is cheaper to produce two outputs together than separately.

- Calculating average incremental cost in a network.
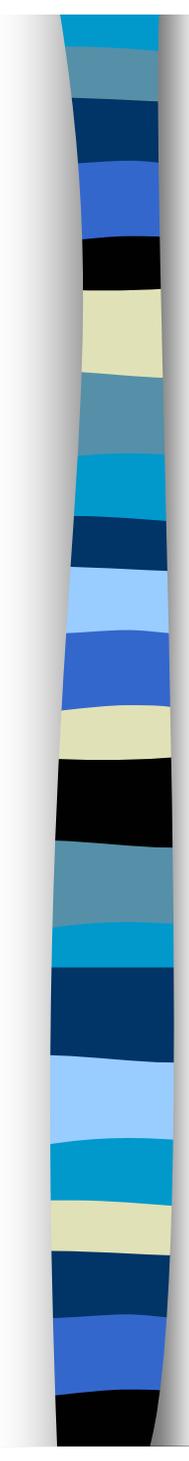
No ATC, AVC, etc. in a network

- A network by definition contains multiple outputs.

- Calculating average costs requires dividing by the level of output. Which?

- Economies of density vs. Scale.

  - Former keeps network same size.

  - Latter increases size of network by 1% when traffic increases by 1%. (Where?).
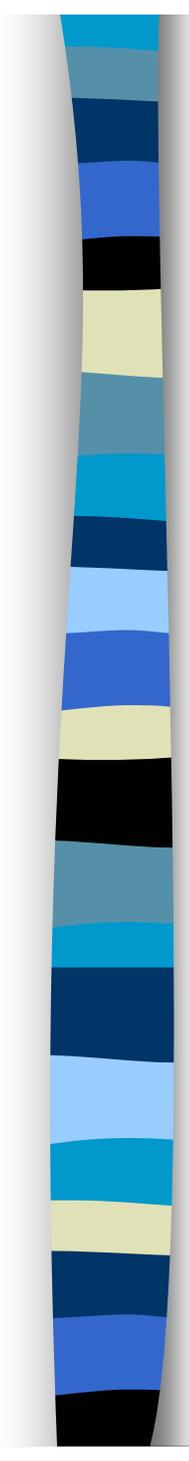
What can be calculated?

- Total cost of operating a network.

- Marginal cost of a type of traffic.

  - Traffic level increased by 1 unit.

- Incremental cost of a type of traffic.

  - Cost saving from eliminating a type of traffic and reoptimizing network.

- Average incremental cost of a type of traffic.

 - Increm. Cost /level of traffic type.

A very simple network
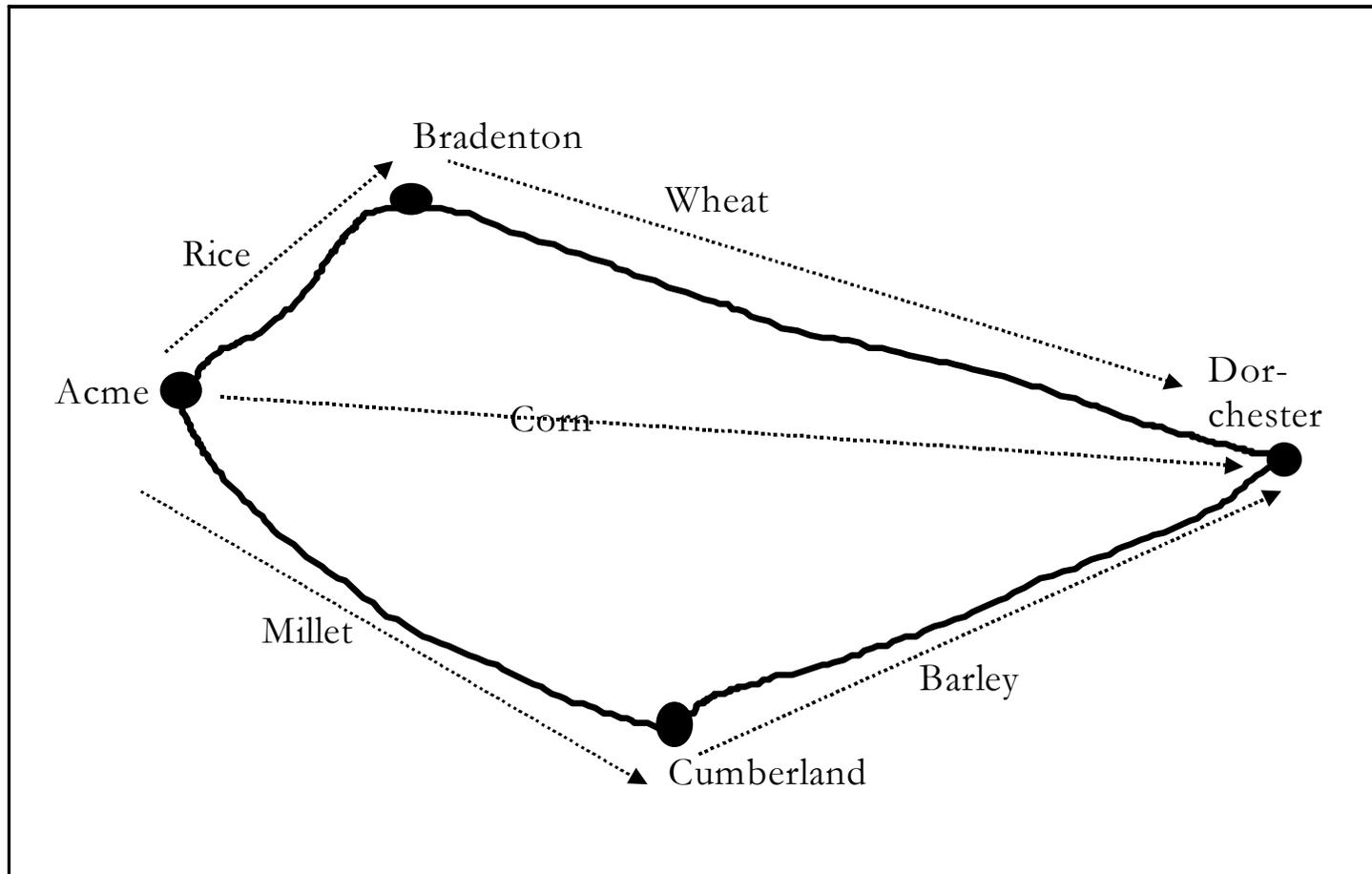
Costs of links and movements

Movement	Commodity	Distance	Variable Cost of Movement	Fixed Cost of Maintaining fixed facilities on route
Acme to Bradenton	Rice	3	3	3
Bradenton to Dorchester	Wheat	12	12	12
Acme to Dorchester	Corn	15 (via Bradenton)	15 (via Bradenton)	
Acme to Cumberland	Millet	10	10	10
Cumberland to Dorchester	Barley	10	10	10
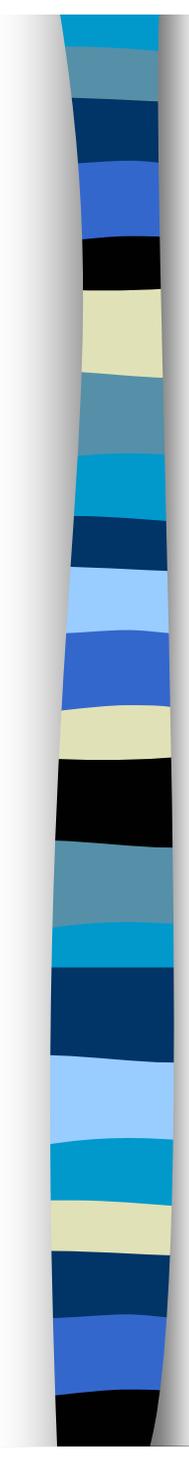
# Remove a flow and reoptimize

- Incremental cost of rice:

  - 3 (because it would still be economical to maintain the A-B link for corn

- Incremental cost of wheat:

  - 19 (because without wheat, it would be economical to abandon B-D and reroute corn on southern route. Corn variable costs rise by 5. Abandoning B-D saves 7.)

- Incremental cost of wheat + rice

 - 25 (30 cost savings - 5 add. Cost for corn)
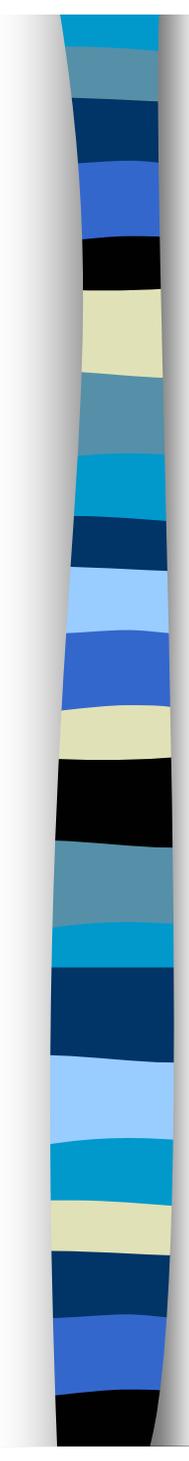
Substitutes or complements?

- Are the different links of the network substitutes or complements?

  – Acme to Bradenton and Bradenton to Dorchester are complements.

  – The northern routes and southern routes are substitutes.

- This mixture of complementarity and substitutability is typical of networks.
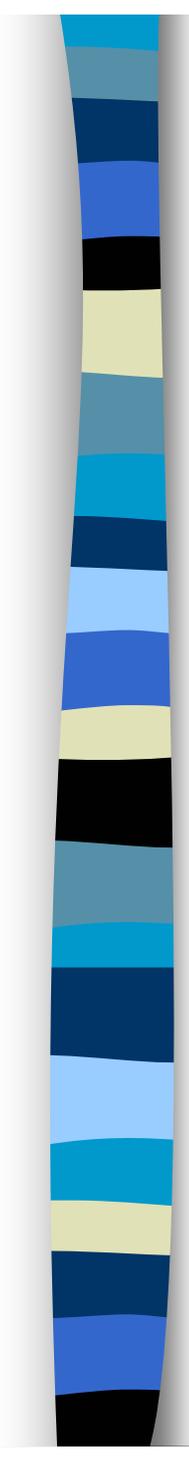
Network costs are complex

- The incremental cost of a sum of flows is not the sum of the incremental costs.

  - Traces back to shared facilities

  - Different types of flows share different facilities.

  - When different types of flows are added or subtracted, the network needs to be differently reoptimized.
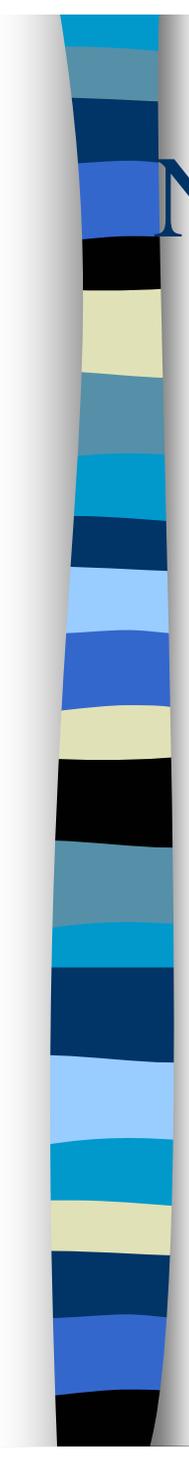
Network costs and natural monopoly

■ The essential characteristic of a natural monopoly is MC<ATC.

– Thus marginal cost pricing can not be a financially successful strategy.

■ In networks, the presence of (uncongested) shared facilities means that charging each user group AIC will not cover total costs.

■ So networks appear to be natural monopolies.
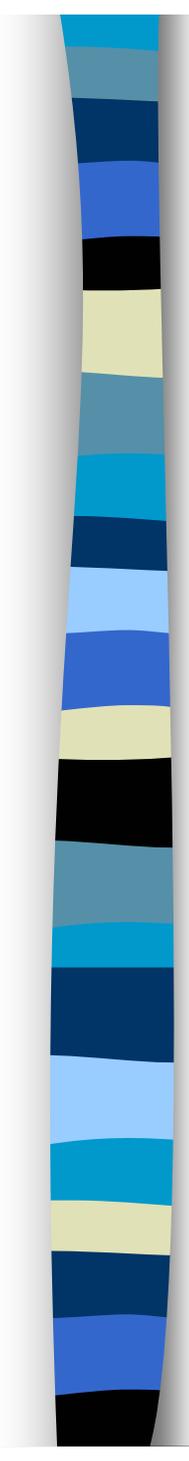
Why do the costing exercise?

- There is an appealing equity in having customers reimburse the seller for costs imposed.

  - This is NOT the economic rationale.

- Efficiency rationale:

  - If people face prices equal to marginal costs when they go to the market, they will make purchasing decisions that maximize the average standard of living in the economy.
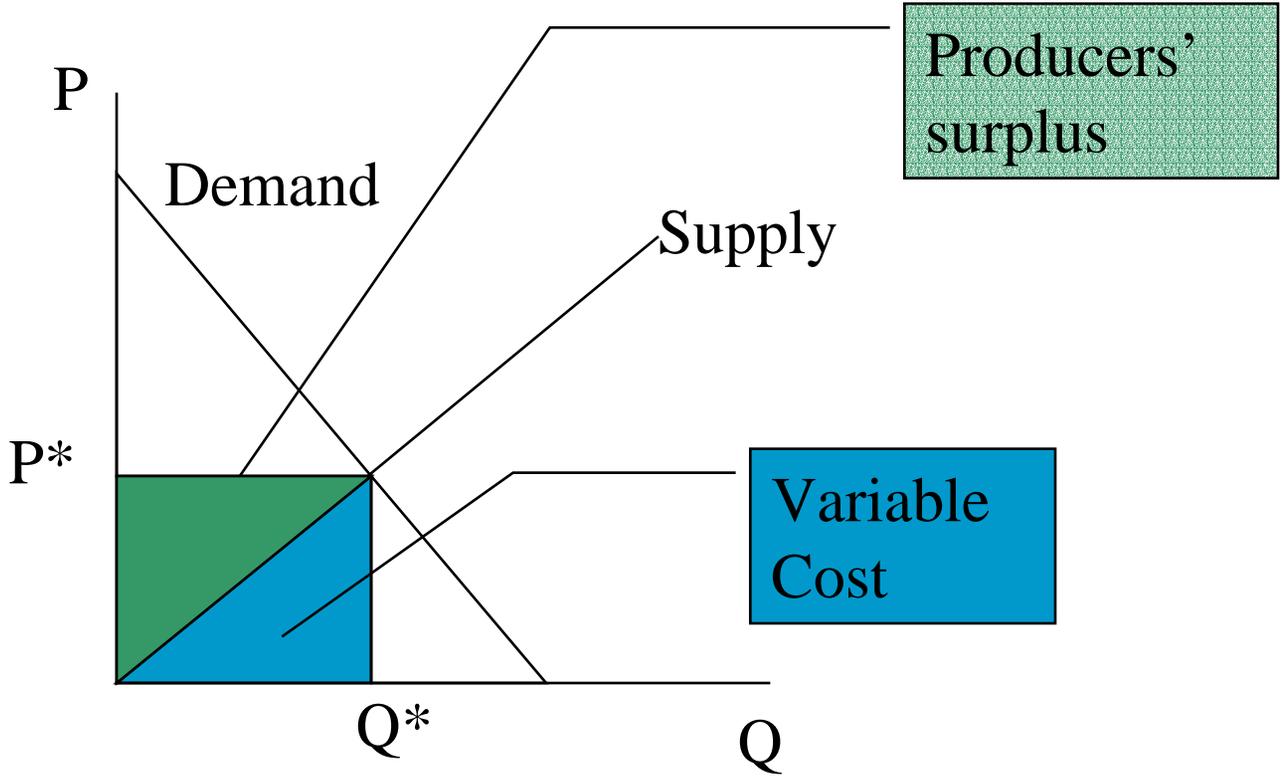
Economic Efficiency

- Pareto optimality is the basis of efficiency.

    - An allocation of resources is Pareto optimal if it is impossible to make one person better off without making someone else worse off.

    - If resource allocation is not Pareto optimal, we forgo raising someone's living standard.

    - We measure living standard by the willingness to pay.

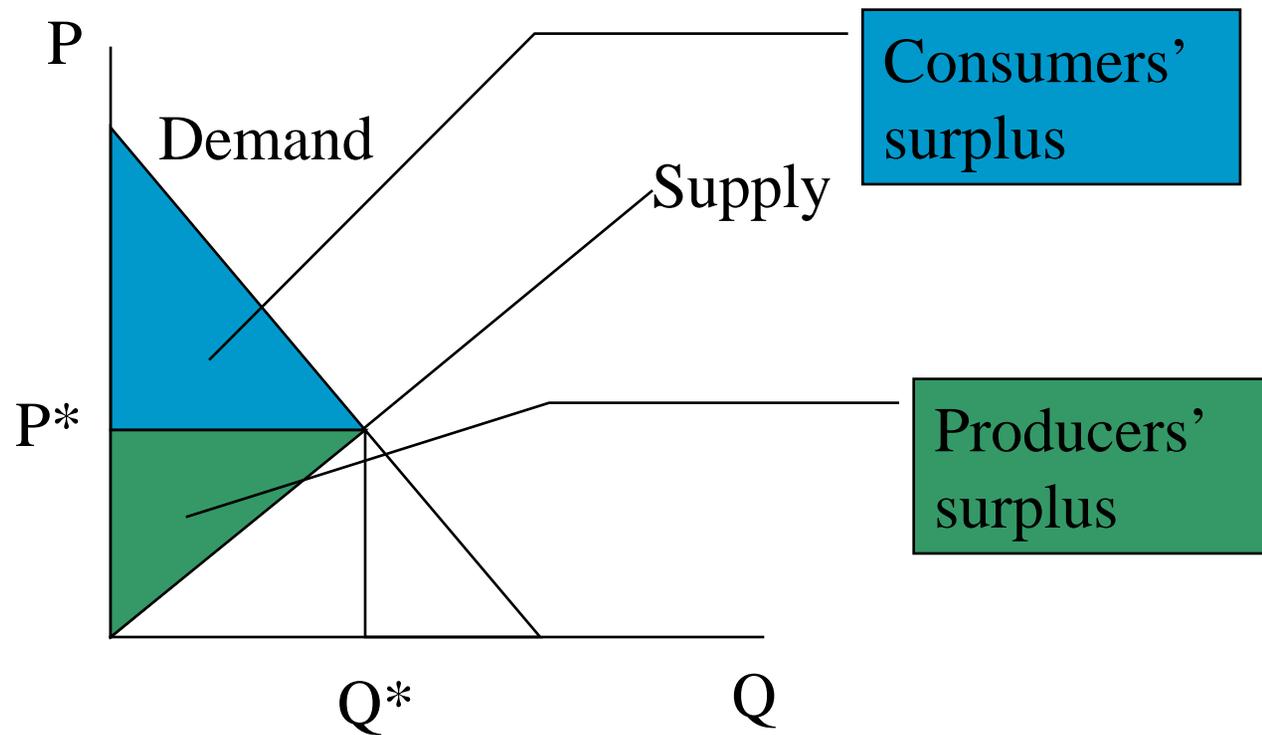   - This is the basis for controversy about economic advice.

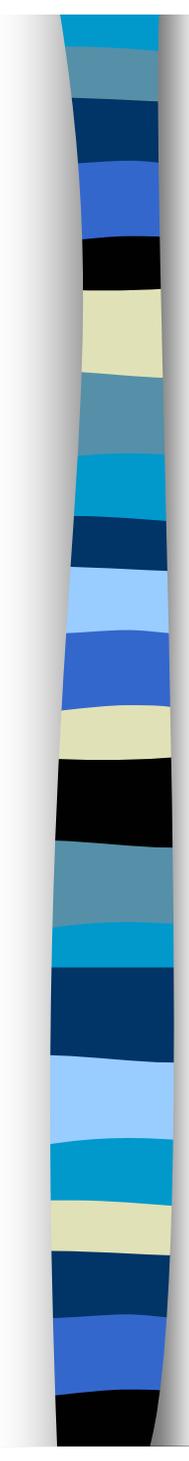# Measuring total benefit of a service

P

Consumers
surplus

Revenue

P*

Q*   Q
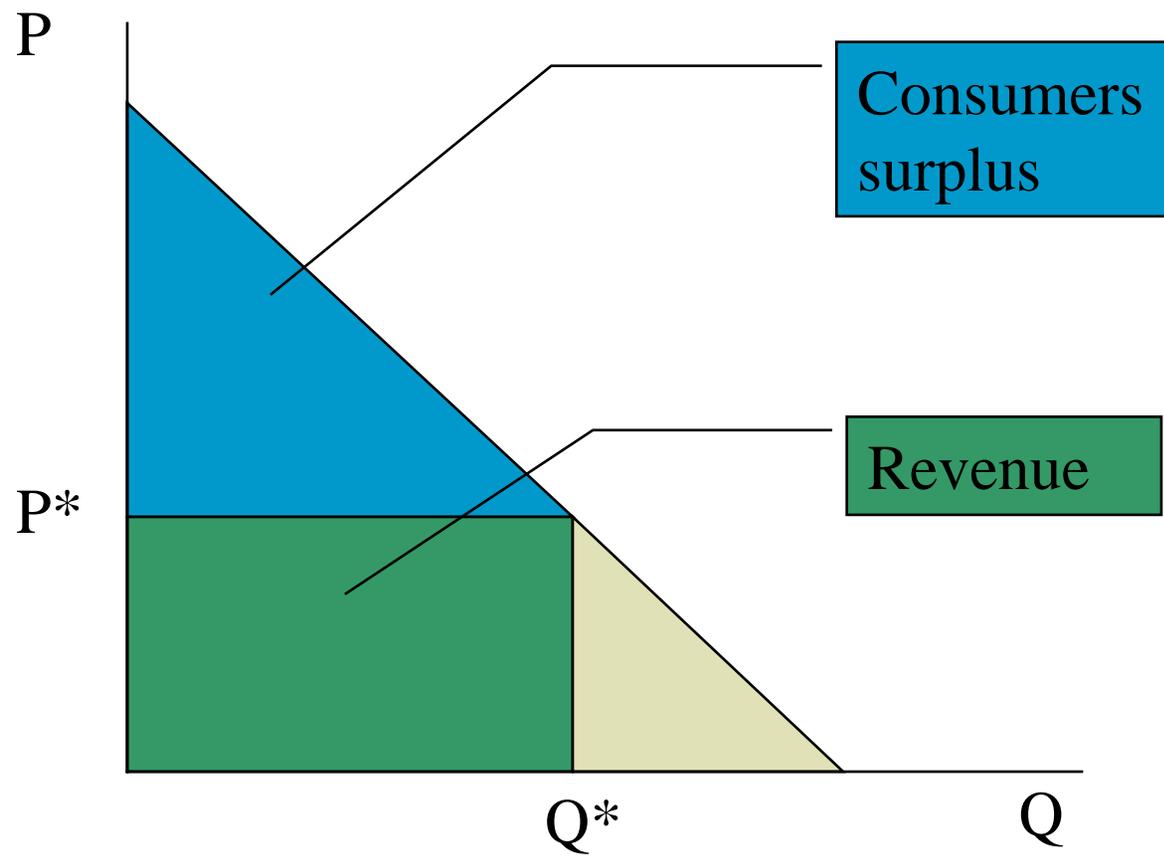
Measuring variable cost of a service

P

Demand

Supply

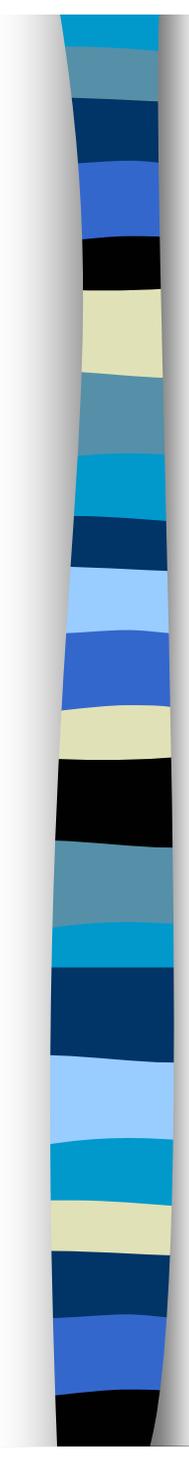P*

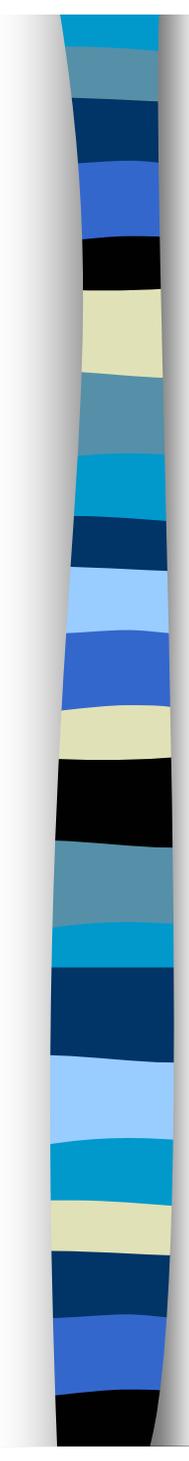Producers' surplus

Variable Cost

Q*

Q

Economic Welfare

(Marginal) cost based pricing is efficient

- If price=marginal cost.

  - Consumers will willingly consume Q*.

  - Producers will willingly offer Q*.

- But Q* is the efficient level of output.

  - The sum of producers' and consumers surplus is maximized.

- Note that firms may not be financially viable, or make excessive profits.

Why be concerned about profitability?

- Equity.

  – We don't really believe that a dollar of consumers' surplus is equal to a dollar of producers' surplus.

- The question of investment.

  – Too high a rate of return will induce excessive investment.

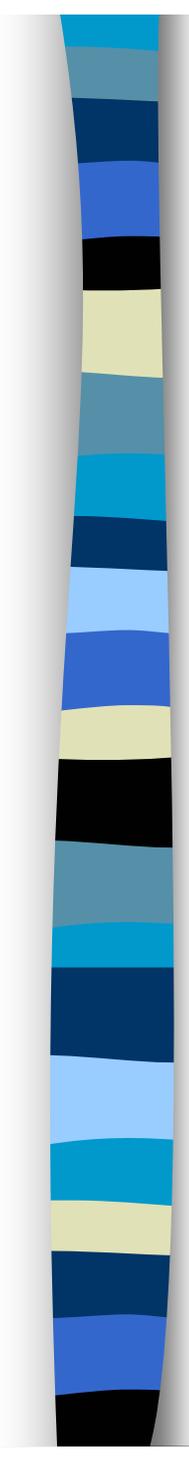 – Too low will cause capital to flee.

Criteria for Investment

■ Private evaluation.

 – Based on profit maximization.

 – Invest if PDV of project is positive.

 – Increase project size so long as MR>MC.

■ Public evaluation.

 – Based on maximization of sum of consumers' and producers' surplus.

 – Invest if (PDV of) surplus is positive.

 – Increase project size so long as MB>MC.

# Network pricing again

- Financial problems with efficient pricing

  – Projects justified by externalities

  – Projects with non-economic (e.G., Military) goals

  – The problem of mistakes

- Should pricing reflect economic costs or financial costs?
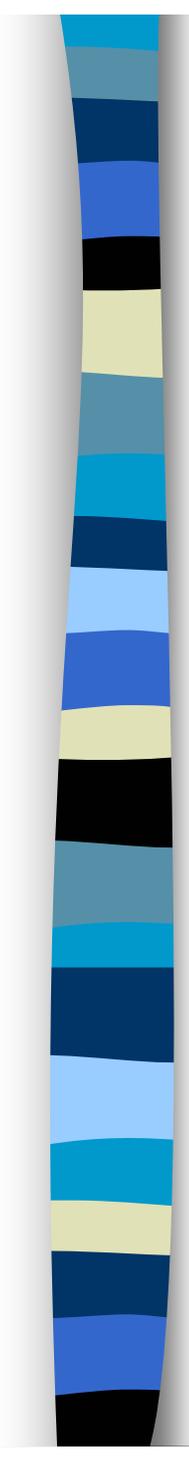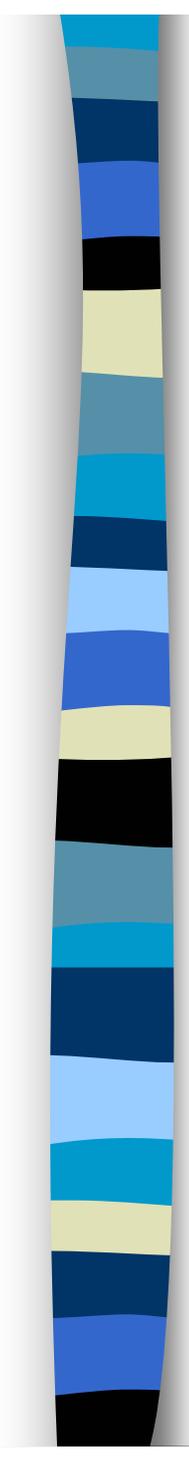
Subsidy-free pricing

- Efficient prices equal marginal cost.

- But these prices may be cross-subsidizing.

- Subsidy free prices are those for which every type of traffic and every possible combination group of traffic pays at least its incremental cost (as defined previously).

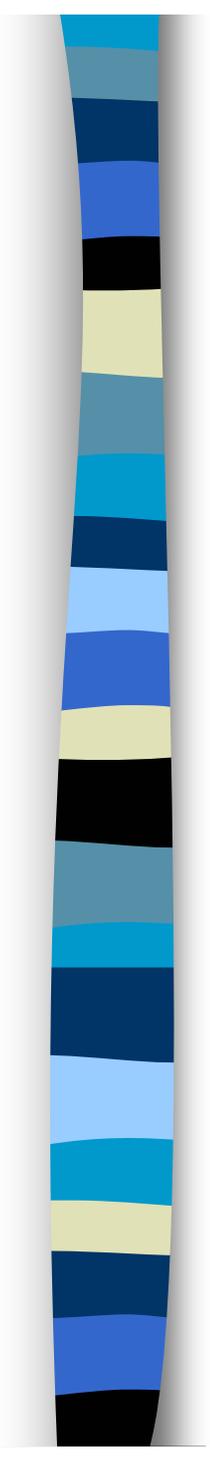   – No group pays more than its stand-alone cost.

The natural monopoly diagram
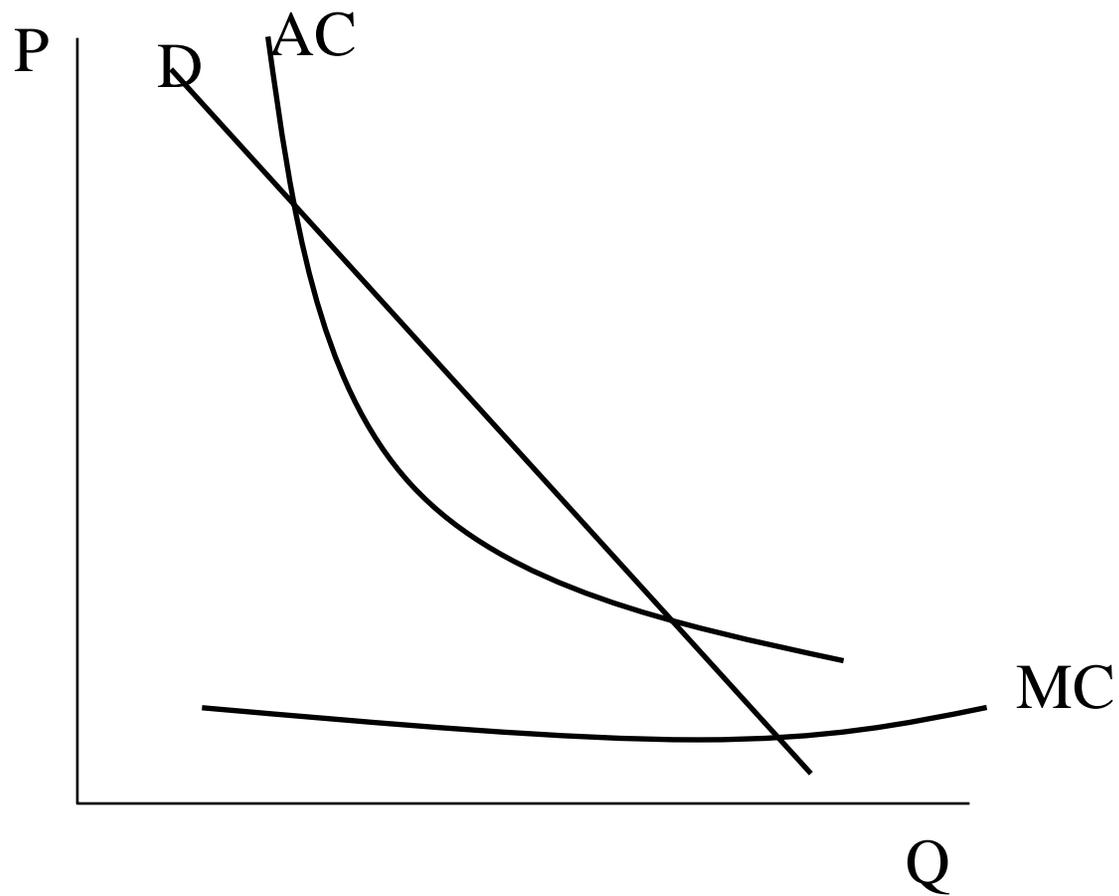
Definitions of Natural Monopoly

- One firm can produce more cheaply than two. (Costs are subadditive.).

- Competition is inherently ruinous to all firms except a single winner.

- Competition leads to wasteful duplication of facilities.

- Marginal cost pricing is not financially viable.

Solutions to Natural Monopoly

- Economic regulation (average cost pricing)

- Block pricing

- Peak-load pricing

- Ramsey pricing

- Franchise bidding

- Isolate the natural monopoly elements
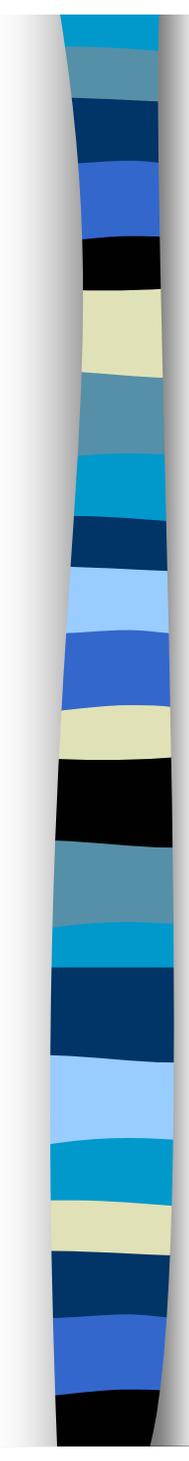
Will competition lead to cost based pricing?

- In the case of Natural Monopoly prices DO NOT tend towards a two-part tariff where the customer pays a fixed price for those services whose costs do not vary with usage and a per-unit charge for services whose variable cost is significant.

- In the case of a service with significant fixed costs, competition is ruinous.

- The FCC got the economics wrong in the CALLS decision.
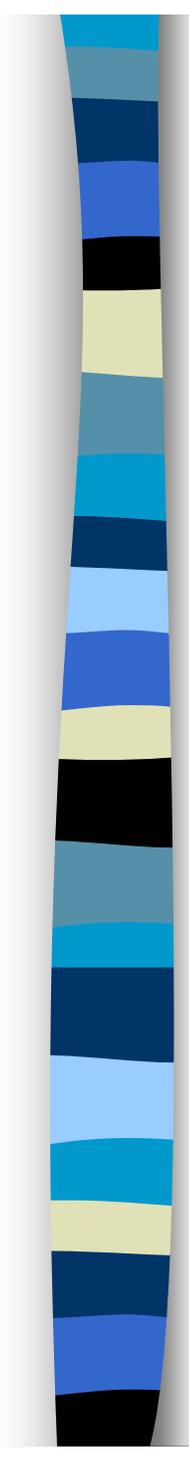
Second Thoughts on the Desirability of Efficient Pricing

- Are external costs pervasive?

- Are consumers fully rational?

- Are we really indifferent between consumers' surplus and producers' surplus.

- Are we maximizers or satisficers?

- What about universal service?
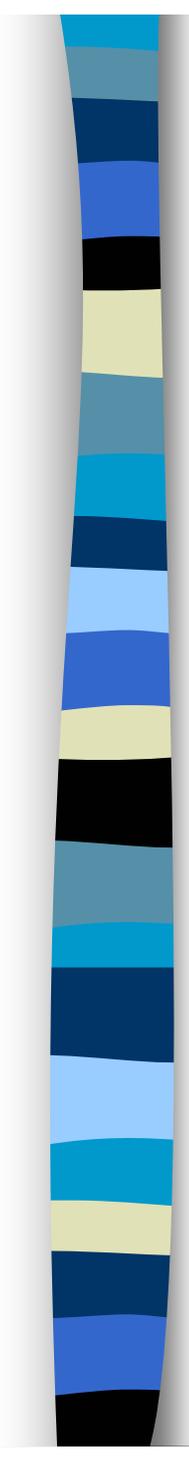
Universal Service

- Free entry will lead to a subsidy free price structure.

- However, this structure does not contain the universal service goal that is considered desirable.

- Two directions:

  - The goal of universal service is illegitimate

    - It violates economic efficiency

  - OR, achieve the goal with minimum economic distortion.

    - This is the direction chosen by the FCC