HCMG 901
COST ESTIMATION

Standard Economic Assumption:
Price = Cost
Health Care Industry
Price ≠ Cost or, there is no price to observe.
Differences between the two occur because:
Consumers do not have adequate information
High levels of insurance
Regulation
Internal pricing policy by hospitals, etc.

Marginal Costs
Marginal costs may vary depending on how you evaluate a program— as temporary or permanent, large or small
Marginal costs generally differ from average costs
Marginal costs (appropriately defined), not average costs (total costs/ total units of service), should always be used in program evaluation (if costs are used at all), regardless of perspective, but often aren’t.

Marginal Versus Average Costs
Suppose that:
Total Drug Costs = $500
Total Doses = 10
Average cost/Dose = $?
Also Suppose that Given Batch Processing:
9 Doses = $490
10 Doses = $500
Marginal Cost/10th Dose = $?

Marginal Costs
Marginal costs: the costs incurred by adding a unit of service or saved in reducing a unit of service (exclude (truly) fixed costs)
Total Costs
MC = slope of line
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Total Costs
MC = slope of line
What are “fixed” costs?
Not costs that are chosen to be constant, but rather those it is impossible or foolish to change with Q. We could keep paying labor when output falls. We could rent buildings. A “true” fixed cost is for an input which:
-- Has logically & economically to be fixed
-- Has no other use, cannot be avoided by shutdown
Space, for instance, could be changed and almost always has another use; it would be costly to renovate every week.
The cost of such alternative-use “fixed” inputs = net benefit in other use. Often zero, but not always.

Non-cost “Costs”
(subtractions to get MSOC)
• Pure profits, monopoly or fortuitous
• Fixed costs
• External benefits
• Transfers
Transfers in CE analysis from societal perspective: Weisbrod et al
- They study the impact of costly program to retrain people with mental illness.
- Benefit is measured by additional earnings.
- B>C if reduced welfare and social security payments are treated as a cost reduction, but not if they are not.
- But these are transfers. Suppose consumption remains the same. What the taxpayers gain the patients lose by having to pay themselves. What if consumption increases? Benefit from self-respect?

Hospital use reductions: measure resources saved as MC or “price”?
- Suppose better statin therapy lowers the use of angioplasty in community hospitals.
- Suppose at current payment rates angioplasty is “profitable,” and profits are used to subsidize charity care.
- “profitable” can mean either P>MC or P>AC (somehow defined).
- Is the saving to society less than P? Yes! What if hospital was for-profit?

When is it hard to measure MSOC?
- when inputs are not purchased
- when intermediate inputs are produced in multiproduct firms
- when inputs are purchased in imperfect markets

Shared or Overhead Costs
Drummond et al. “The main point to note at the outset is that there is no unambiguously right way to apportion such (overhead and joint) costs.” This is incorrect. The right way is to ignore such “costs” if their level is unaffected by the decision in question, no matter what the accountants say, but to allocate them based on the way they really vary with output if they do.

Allocating overhead in practice
2 Issues
  Basis for allocation
  Method for allocation
Accountants: Pick the base your boss likes, and make sure to allocate everything.
Econs: Use bases that are “true”; use interactive method; ignore the rest.

But there are “global” decisions for which truly shared or fixed costs matter

Example:
<table>
<thead>
<tr>
<th>Input Type</th>
<th>Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient care only</td>
<td>$3M</td>
</tr>
<tr>
<td>Research only</td>
<td>$2M</td>
</tr>
<tr>
<td>Research and Care</td>
<td>$4M</td>
</tr>
<tr>
<td>MC of Care</td>
<td>$2M</td>
</tr>
<tr>
<td>MC of Research</td>
<td>$1M</td>
</tr>
<tr>
<td>Joint Cost</td>
<td>$1M</td>
</tr>
</tbody>
</table>

Suppose the benefit from care was $2.8M and the benefit from research was $1.3M. What decision should be taken? What should happen if benefit from care fell to $2.6M?

Basic Rule
\[ MB_i > MC_i \text{ and } \sum MB_i > \text{TOTAL COST} = \sum MC_i + \text{JOINT COST} \]
**Hospital Costs in CB/CE Analysis**

*(Taken from Martin and Boyer)*

Suppose a new program would require an additional day of level 1 acuity care, accounting costs are as follows:

<table>
<thead>
<tr>
<th>Cost Type</th>
<th>Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Nursing</td>
<td>Time on floor</td>
</tr>
<tr>
<td>Hospital Admin.</td>
<td>Nursing expense</td>
</tr>
<tr>
<td>Patient service</td>
<td>Charges</td>
</tr>
<tr>
<td>Hotel</td>
<td>Days</td>
</tr>
<tr>
<td>Nursing Admin.</td>
<td>Nursing expense</td>
</tr>
<tr>
<td>Residents</td>
<td>Time in dept.</td>
</tr>
<tr>
<td>Corporate tax</td>
<td>Nursing expense</td>
</tr>
<tr>
<td>Physician</td>
<td>Time in dept.</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
</tbody>
</table>

What is MC (approximately)?

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**Opportunity Cost Under a Fixed Budget**

A hospital is operating under a hiring freeze. The staff of a department is currently 50 persons, with daily expenses of $5000 (or $100 per person), and currently produces a program valued at $6000 per day. No additional staff may be hired. A new program is proposed which would require 10 staff members to be used. What is the right measure of cost? Which is the best measure of cost?

- $1000
- $1200
- need to know impact of staff reduction on current program’s benefit level

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**Stochastic Marginal Costs**

- suppose that hospitals use “administrative managers” to coordinate nurses and other staff
- suppose that an intervention will require 2 hours less of this person’s time per patient, and that 50 patients are affected.
- suppose that this person’s total compensation is $30,000 per year
- suppose that 19 out of 20 hospitals say that this will not cause them to change their hiring of managers, while one hospital says that it will discharge one manager

Queries: 1) Is this manager a fixed or variable input?
2) What is MC of this input?

Answers: 1) Accountants will say “fixed,” but they will be wrong
2) MC = 0.05 X $30,000 = $1,500

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**Stochastic MC continued.**

- Is $1500 a better estimate than calculating wages per hour times hours saved?
- The typical hospital would not change any resource purchase if 100 hours to time were freed up.
- In this example, assuming 2000 hours of work per year, it would come out the same. But what if 200 patients had been affected? 10?
- Perhaps measure the value of the 100 hours in other uses?

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**When inputs are not purchased, you have to estimate their price**

E.g., parents’ time donated services: what value to use?
fixed quantities

When intermediate inputs are produced in multiproduct firms, there is likely to be “overhead” cost to be allocated. Already discussed.
When inputs are supplied by monopoly or union, price = cost

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**Methods of Institutional Cost Estimation**

Costing out a theoretical model

Component enumeration (or micro-costing or bean counting): (e.g., time and motion/work sampling, counting supplies)

“Gross” costing: disaggregated “costed” intermediate services Adjust charges using cost-to-charge ratios

Cost accounting system costs

Regression techniques

DRGs and other payment systems designed to approximate true costs
Regression Approaches

Cost-Minimizing: regress total cost on outputs, input prices, other things

Enveloped: Regress non-“fixed” costs on outputs, price of non-fixed inputs, quantities of fixed inputs, other things

Yields SMC directly. You can recover LMC by adding to SMC the cost of fixed inputs at their optimal levels $x^*$. $x^*$ is that value of $x$ at which

$$\frac{\partial TVC}{\partial x} = \text{price of } x$$

what if $\frac{\partial TVC}{\partial x} < 0$?

Regression Approach vs. Bean Counting

RA requires larger samples
BC requires more and more debatable measures
RA automatically allocates such overhead as it is legitimate to allocate
BC uses rules or judgment to allocate all costs that can’t be tested.
BC can miss “hidden” cost effects
RA can produce spurious findings, especially if there are correlated omitted variables

Example of Regression Equation

• Dependent Variable:
  – Costs/department/period
  
ex. Monthly laboratory expenditures
  Monthly ward expenditures
  Monthly outpatient department costs
  Monthly practice costs

Deriving Practical MC Estimates from Regressions: Bridges and Jacobs

• Step 1: Collect monthly cost and revenue data for each department (they used revenue producing departments and allocated costs to these departments using step-down techniques). Adjust revenues to get total departmental costs. Use the departmental ratio of changes to cost to get an estimate of departmental cost per DRG.

• Step 2: Collect monthly output data for each department used in the analysis.

• Step 3: Regress the output data on the monthly cost data (correcting for inflation if you have data over an extended period of time). The intercept equals the fixed portion of the of the monthly cost and the coefficient on the output measure equals the marginal cost.

• Step 4: Calculate the MC/AC ratio for each department.

• Step 5: Multiply each departmental average cost per DRG by this ratio to get marginal cost per department per DRG

• Step 6: Add the marginal costs.
Hospital Productive Efficiency

Cost function:
\[ TC = f(Q, w, E) \]

Marginal cost

Economies of scale: average cost falls as output rises

Economies of scope:
\[ C(Q_1, Q_2) < C(Q_1) + C(Q_2) \]

Explain Regression

### Table 4
Per Visit Costs and Economies of Scale for Hospital Outpatient Care, by Levels of Outputs.

<table>
<thead>
<tr>
<th>Level of Inpatient Days</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal Cost (Dollars)</td>
<td>112</td>
<td>154</td>
<td>69</td>
</tr>
<tr>
<td>Product-Specific Economies of Scale (Dollars)</td>
<td>2.16</td>
<td>1.86</td>
<td>1.29</td>
</tr>
<tr>
<td>Level of ED Visits</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Marginal Cost (Dollars)</td>
<td>71</td>
<td>106</td>
<td>135</td>
</tr>
<tr>
<td>Product-Specific Economies of Scale (Dollars)</td>
<td>2.43</td>
<td>1.86</td>
<td>1.29</td>
</tr>
</tbody>
</table>

### How Should the Cost of Drugs Be Measured from the Societal Perspective?

What theory says….

- In general, measure MSOC
- This would not include any economic profit, or costs which are properly fixed given the definition of “run.”
- It would include any external effects (e.g., antibiotic resistance).

What the Gold Book says…

- Distinguishes “first copy” cost from usual MC.
- “R&D costs should be included if the decision addresses whether to provide the intervention at all.”
- “In the case of drugs, MC is often significantly less than P, especially during periods of patent protection…The level of effort to handle these costs is beyond the resources for analysis…” What does this mean?
- “Because the class of drugs must break even…, prevailing transactions prices will usually act as a serviceable way to value consumption of the drugs. AWP is one source of such information.” LMC is clearly not greater than AWP but still could be much less.
Interpreting the diagram (and footnote #1)

- Optimal quantity if drug is invented is $Q^*$.  
- Check to see if $R$ is greater than consumers' surplus.  
- You could use $C(Q^*)$ as "price" but it depends on where the $D$ or $MB$ curve is.  
- But $C(Q^*)$ is below the market price even if the seller breaks even. And $Q^*$ is possibly greater than use at that price.  
- If you set quantity at $Q^*$ but calculate "cost" as $Q^* \times$ market price, you get the wrong estimate of cost.

So what to do?

- Nibble the edges: take out economic profit from AWP; guess if your intervention is a new or old use. Niacin and lovastatin in the sample case study? Is MC of lovastatin $2 per pill?  
- 2nd best: Solve for the $Q$ which will be chosen, given market pricing and insurance coverage, then calculate whether net benefit is positive. It must be positive at $Q_M$. Why? But then who needs analysis? If drug can be profitably offered, it should be.

What do people actually do these days?

| TABLE 1 |
|-----------------|-------|-------|
| Cost Measure    | New Drugs | Old Drugs |
| AWP             | 5      | 4      |
| Marginal Cost   | 0      | 0      |
| Market Price    | 5      | 6      |
| Insurer Acquisition or Official Tariff | 3 | 5 |

Kremer on prospective pricing

- Michael Kremer at Harvard has argued for setting a price in advance for yet to be invented drugs based on the value of cure—estimated from demand curve.  
- Price (and quantity) are set so that some fraction of the gain is promised to whomever invents this product, if anyone does.  
- Work for Alzheimers, malaria vaccine, AIDS vaccine?  
- Then we won’t need to do CE analysis, only “E” analysis.

Some Issues

- What if $R$ is less than consumers surplus but greater than profit for non-discriminating monopolist? What if drug firm faces a single government buyer? Provide $Q^*$ and charge $0DBQ^*$?  
- How to calculate economic profit? For generics? For patent protected brand drugs?
Some Ideas I

• In a setting with private markets and patents, would it be efficiency-improving to subsidize from QM to Q*?
• It would in the short run, but gains would go to drug stockholders.
• Would it produce excessive incentives for R&D and therefore excessive R&D? Compare additional profit \((Q^* - QM)(PM - MC)\) to “lost triangles.” If demand is linear so \(Q^* = 2QM\), looks like “it all depends.”

Some Ideas II

• The intercept (price at which Q falls to zero) is an elusive concept, but there may be a way to define these things in terms of elasticities.
• But why would firm set its price at PM if it knew it would get a subsidy at whatever price it set?
• So it is hard to be “a little pregnant” or “a little subsidized.” Hard to see how to do this in a decentralized way. Cannot reconcile market prices with CE analysis.
• But is there a rule for subsidy that could work that would specify both quantity (at Q*) and a subsidy equal to the lower triangle? A 50% of profit subsidy?
Treatment of “Societal” Costs:
What we say or what we do?

Stinnett et al., The CE of Dietary and Pharmacologic Therapy for Cholesterol Reduction in Adults

The Perspective

• The present study is a cost effectiveness analysis. The results are presented as incremental cost effectiveness ratios.
• Because this analysis is intended to inform resource allocation decisions at a societal level, the societal perspective has been adopted.
• The strategies for primary prevention: dietary therapy, pharm. Therapy with niacin, pharm therapy with lovastatin, and “do nothing” with no therapy administered. Plus a variety of secondary prevention therapies for people with CHD history.
• Population: adults 35-84.

Estimating Prevention Costs

Office visits: 15 minute visit for established patient, based on RBRVS = $33. Patient time: travel, wait, visit: average hourly earnings x average hourly wage by age. Discounting costs and QALYs at 3%. Lab costs: average Medicare payment, e.g., $12 per HDL test.

Estimating Medication Costs

• Niacin: HCFA’s federal upper limit price for Medicaid: $2.84/100.
• Lovastatin: 1994 AWP--$2 per 20 mg tablet. Now could be less than $1.
• Annual drug costs: $53 for niacin only to $1322 for high dose lovastatin plus niacin.
• Aspirin: 0.7 cents per tablet.

Estimating treatment costs

• Hospital costs for cardiac procedures and MI: sum of components reflecting accommodation and ancillary costs, reduced to costs by RCC ratio. (Table C.6)
• Total costs for hospitalization with CHF: MD fee from trial. Angina hospitalization from Angina DRG.
• Total MD costs for cath, PTCA, CABG: RBRVS

Treatment costs continued

• Outpatient costs: average # of visits per patient with CAD x average cost per visit for patients with CAD. The latter was estimated “from an analysis of Medicare beneficiaries at cardiovascular clinics in 1992”.
• Other meds: actual payments in a clinical trial. “Although resource consumption by patients participating in a clinical trial might not be representative, no better estimates were available.”
Non CHD costs (unrelated)

• Per capita medical costs from NMES, adjusted to avoid double counting.
• “More precise estimates of these costs is recommended as a topic for future research.”

Results

• See table C.8—20–40mg stepped care for men, 20–40 mg lovastatin for women(?) might be accepted.
• Sensitivity to medication costs: AWP for lovastatin may exceed MC. Cut lovastatin price in half and raise niacin price 5X. Few changes, except for moderate risk women—$/QALY for lovastatin as first line fall to $48K. Cuts costs per QALY by about 75% for other high lovastatin treatments.

Conclusions

• Results sensitive to cost of lovastatin.
• Would you use this model for a decision if you were in charge of society?
• Today’s price of 20mg lovastatin at Costco: 55 cents