Economic Costs and Their Use in CEA/CBA

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Bottom Line

• The theory of cost measurement is helpful in practice applications
  – Useful for deciding what to include in our tally of costs and what to exclude
  – Useful for the valuation of what is included

Outline - Costs

• For whom do we measure cost?
• Definition of economic costs
• Review of marginal cost
• Consider Costing issues
  – Fixed costs and time horizon
  – Transfers
  – Profits
  – Use of resources outside of market
Perspective:
Whose costs are we measuring?

- Will depend on perspective:
  - Society, patient, insurer, ministry of health

- Costs typically occur in following categories
  - Patient/family
    - out-of-pocket medical costs
    - time and inconvenience associated with treatment
  - Health sector
    - costs of organizing and providing care
  - Other sectors
    - Costs related to care outside health sector (eg. social workers)
    - Productivity losses
    - Patients and deadweight loss from taxation

Societal Perspective

- Societal perspective: Considers effects on everyone in society
  - Parties directly involved in the intervention
    - Providers and patients
  - Parties indirectly involved
    - Family members
    - General taxpayer

- Social perspective is primary, but other perspectives are not irrelevant
  - Is the social outcome in accord with more narrow perspectives
  - Reveals incentive compatibility problems

Cost definition: Opportunity Cost

- Opportunity cost: the foregone opportunity by using resources for a particular use rather than for some other (best) use.

- Opportunity cost is different from money payments
  - Sales tax does not use resources. It is a transfer between individual and gov’t
  - Drug samples involve resources, but no money paid
  - Is the amount a hospital charges for its services a good representation of opportunity cost?
Costs for Social efficiency:
Marginal Social Opportunity Cost (MSOC)

- The MSOC represents the value of all resources consumed or reduced by the program in their next best use.
  - We want to value resources consumed (social), not just money spent
- Thus this is the cost we want to apply to each resource consumed
- Where do we find this “price” for a particular resource?

Marginal Social Opportunity Cost (MSOC):
can be a challenge to find in health care markets

- In a perfectly functioning competitive market the market price of a good or service reflects its marginal social opportunity cost.
  - The last consumer values that good at its price
  - The cost of the last good produced (marginal cost) is equal to its price
- Price in a competitive market is often difficult to observe in the health care industry
  - Price = Cost or, there is no price to observe.
- Why?
  - Health care industry deviates from perfect competition
    - Consumers do not have adequate information
    - High levels of insurance
    - Regulation
  - Internal pricing policy by hospitals, etc.

Challenges for costing

- Situations when spending may not be the same as MSOC:
  - Fixed costs and time horizon
  - Profits
  - Transfers
  - Use of resources outside of market
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Costs in the Short Run: fixed and variable costs

• Fixed Costs (FC): cost that does not vary with the level of output in the short run. It is the cost of all fixed factors of production.

• Variable Costs (VC): cost that does vary with the level of output in the short run. It is the cost of all variable factors of production.

Costs in the Short Run: Example

• Consider a doctor’s office with nursing labor (L)
  – Wage rate (w) = $10/person-hr
  – Rental of examination room (r) = $10/room-hr
  – Capital is fixed (K) at 3 rooms

  Fixed costs: \( FC = r*K \)
  \( = 10 \times 3 \)
  \( = 30 \text{ hr} \)

  Variable costs: \( VC = w*L \)
  \( = 10*L \)

  Total costs: \( TC = FC + VC = 30 + 10*L \)

• Now we must relate costs based on inputs (K,L) to output:
  – This depends on the production function
  – How many patients can be seen based on the number of nurses?
Output as a Function of One Variable Input

Derive Cost Curves

<table>
<thead>
<tr>
<th>L</th>
<th>Q</th>
<th>FC=30</th>
<th>VC =10*L</th>
<th>TC=FC+VC</th>
<th>AVC =VC/Q</th>
<th>ATC =TC/Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>2.5</td>
<td>10</td>
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<td>2</td>
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<td>30</td>
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<td>50</td>
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<td>3.6</td>
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<tr>
<td>3</td>
<td>27</td>
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<td>30</td>
<td>60</td>
<td>1.1</td>
<td>2.2</td>
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<tr>
<td>4</td>
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<td>30</td>
<td>40</td>
<td>70</td>
<td>1.0</td>
<td>1.7</td>
</tr>
<tr>
<td>5</td>
<td>51</td>
<td>30</td>
<td>50</td>
<td>80</td>
<td>1.0</td>
<td>1.6</td>
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<tr>
<td>6</td>
<td>57</td>
<td>30</td>
<td>60</td>
<td>90</td>
<td>1.1</td>
<td>1.6</td>
</tr>
<tr>
<td>7</td>
<td>61</td>
<td>30</td>
<td>70</td>
<td>100</td>
<td>1.1</td>
<td>1.6</td>
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<tr>
<td>8</td>
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<td>30</td>
<td>80</td>
<td>110</td>
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<td>1.7</td>
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<tr>
<td>9</td>
<td>66</td>
<td>30</td>
<td>90</td>
<td>120</td>
<td>1.4</td>
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<tr>
<td>10</td>
<td>67</td>
<td>30</td>
<td>100</td>
<td>130</td>
<td>1.5</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Average Cost Curves
Law of diminishing marginal returns

- Variable costs grow at different rates with output
  - Increasing returns to labor
    - When the additional nurse produces more output than the previous nurse
    - Variable costs grow at a diminishing rate
    - Efficiencies of specialization
  - Decreasing returns to labor
    - When the additional nurse produces less output than the previous nurse
    - Variable costs grow at an increasing rate
  - Law of diminishing marginal returns
- Increasing returns to scale followed by decreasing returns to scale results in a U-shaped average cost curve

Derive Marginal Cost Curve

<table>
<thead>
<tr>
<th>Q</th>
<th>TC</th>
<th>∆Q</th>
<th>∆C</th>
<th>MC = ∆Q/∆C</th>
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<tbody>
<tr>
<td>0</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>4</td>
<td>10</td>
<td>2.5</td>
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<td>10</td>
<td>5.0</td>
</tr>
<tr>
<td>67</td>
<td>130</td>
<td>1</td>
<td>10</td>
<td>10.0</td>
</tr>
</tbody>
</table>
Marginal Cost Curves

• When MC is less than either ATC or AVC, the average cost curves must be decreasing with output; and when MC is greater than average cost, average cost must be increasing.
  – The MC curve must always intersect both the ATC and AVC curves at their minimum points.
• The firm’s decision of how much output to produce is based on marginal costs – not average costs.
  – Costs should be based on marginal costs and not average costs.

Costs of an X-ray

• What would go into determining the marginal cost?
• How might that differ from:
  – average variable cost?
  – average total costs?
• What is the role of the time horizon of interest?

Marginal vs. Average Variable Cost

Suppose that:
Total Variable 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 cost when comparing two treatments

- Consider incremental comparison of discrete alternatives
- Only the comparison matters
- Consider treatments A and B with costs C
  \[
  C_A = F + V_1 * b_1 + V_2 * b_{2A} \\
  C_B = F + V_1 * b_1 + V_2 * b_{2B}
  \]
- What is the incremental cost of \( C_A \)?
  \[
  = V_2 * (b_{2A} - b_{2B})
  \]
- Only need to consider costs that vary between programs

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Short run vs. long run considerations

Drug costs

Remember the example of the marginal cost of the 10\textsuperscript{th} drug dose: $10

Now consider the fixed costs of drug development = $1000
Suppose that:

- Total Drug Costs = $1500
- Total Doses = 10
- Average cost/Dose = $150

What drug cost should be used in the economic evaluation?
Cost definition: Changes from the short run to the long run

- The alternative use of a resource depends on time horizon: if it is long enough it might be possible to find an alternative use for the hospital.
- Consider hospital costs in the short run:
  - Cost of hospital is fixed for accommodating a new mode of treatment when:
    - Costs can not be avoided if treatment was not given
    - A new hospital does not have to be built to accommodate treatment
    - Hospital space can not reasonably be rented out for another purpose
  - Costs of nursing, physician services and medication are variable when:
    - They will be greater the larger the scale of treatment evaluated
- How is it different in the long run?

Cost definition: Changes from the short run to the long run

- Long run – all costs are variable
  - Hospital could close down if the building could be renovated and used for another activity
  - Hospital input can be adjusted to find the combination of inputs that results in the least costs.
  - Can use interest payment on capital invested to account for hospital cost

Long Run Costs of Production

- In the long run, all inputs are variable.
  - \( k \) is no longer fixed.
  - e.g. A hospital can build a new facility or add extra floors to increase bedsize in the long run.

- If all inputs are variable, what does the long run average cost curve look like?
Long run average cost curve

Each small U-shaped curve is a SRATC curve.

The LRAC curve.

$/Q

Number of patients

Long Run Cost Curve

• Just like the short run cost curve, the long run cost curve for a firm is also u-shaped.
  – In the short run, the only way to increase the number of patients treated was to hire more nurses, but the # of beds (k) was fixed.
  – But in the long run, there are no fixed inputs.
• LRAC curve is below all SRAC curves
• Marginal costs are lower in the long run
  – long run marginal cost curve is usually higher than short run marginal cost curve at any level of output because there is more freedom to adjust to the ideal level in the LR

Practical implications:
Short run vs. long run

• Helps determine which resources should be included in the determination of costs of treatment
  – Costs and resources that are fixed are typically excluded from an economic evaluation of the costs of a new therapy
• “price” of resource may be lower in the long run because of lower marginal costs
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. (eg. square feet of space)

**Econs:** Use bases that are “true”
  - Relate to output (eg. patient days)

---

What should be included is not always straightforward:
There are “global” decisions for which truly shared or fixed costs matter

**Example:**

<table>
<thead>
<tr>
<th></th>
<th>Costs</th>
<th>Benefits</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient care only</td>
<td>$3M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research only</td>
<td>$2M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research and Care</td>
<td>$4M</td>
<td>4.1M</td>
<td>3.9M</td>
</tr>
<tr>
<td>MC of Care</td>
<td>$2M</td>
<td>2.8M</td>
<td>2.6M</td>
</tr>
<tr>
<td>MC of Research</td>
<td>$1M</td>
<td>1.3M</td>
<td>1.3M</td>
</tr>
<tr>
<td>Joint Cost</td>
<td>$1M</td>
<td></td>
<td></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**

\[
MB_i > MC_i \text{ and } \sum MB_i > \text{TOTAL COST} = \sum MC_i + \text{JOINT COST}
\]

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Example CB analysis

- Intervention: program to retrain people with mental illness to work when they are generally reliant on social security and welfare

- What categories of costs and benefits should be considered in this analysis?
  - Perspective?

Example CB analysis
(Weisbrod et al., 1980)

<table>
<thead>
<tr>
<th>Category</th>
<th>Control</th>
<th>TCL</th>
<th>Savings or Costs of TCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Direct Treatment</td>
<td>($3,138)</td>
<td>($4,798)</td>
<td>($1,660)</td>
</tr>
<tr>
<td>(2) Indirect Treatment Costs</td>
<td>($2,142)</td>
<td>($1,838)</td>
<td>$304</td>
</tr>
<tr>
<td>(3) Law Enforcement</td>
<td>($409)</td>
<td>($350)</td>
<td>$59</td>
</tr>
<tr>
<td>(4) Transfers + Admin</td>
<td>($1,098)</td>
<td>($534)</td>
<td>$564</td>
</tr>
<tr>
<td>(5) Other Maintenance Costs</td>
<td>($389)</td>
<td>($501)</td>
<td>($112)</td>
</tr>
<tr>
<td>(6) Family Burden</td>
<td>($120)</td>
<td>($72)</td>
<td>$48</td>
</tr>
<tr>
<td>(7) Total Costs (SUM)</td>
<td>($7,296)</td>
<td>($8,093)</td>
<td>($797)</td>
</tr>
</tbody>
</table>

8) Total Monetized Benefits | $1,168 | $2,364 | $1,196
9) Effect of Program(7) +(8) | ($6,128)| ($5,729)| $399

How should transfers be treated?
Social Perspective

- A reduction in transfer payments produces a gain for the taxpayer equal to the reduced payments to the patients
  - It is just a transfer or redistribution of dollars
  - It does not represent any resources consumed
- Not exactly zero cost
  - Administrative costs: costs incurred from the activity of transferring funds: determining eligibility, administering payments, ...
  - Do the payments serve as a work disincentive this reducing worker productivity?
  - Is there "dead-weight loss" associated with taxes levied to finance the program?

- DON’T INCLUDE DIRECT TRANSFERS, ONLY REAL COSTS
  - What about non-tangible benefits ... self respect.
Example CB analysis
(Weisbrod et al., 1980)

Removing Transfers changes the conclusions:

<table>
<thead>
<tr>
<th>Category</th>
<th>Control</th>
<th>TCL</th>
<th>Savings (Costs) of TCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>9) Effect of Program</td>
<td>(77,082)</td>
<td>($5,720)</td>
<td>$120</td>
</tr>
<tr>
<td>(10) Effect of program removing transfers</td>
<td>($5,118)</td>
<td>($5,238)</td>
<td>($120)</td>
</tr>
</tbody>
</table>

- **Weisbrod justification:** "We include these transfers payments as costs because they were subsequently used for maintenance (food, shelter, etc.) which does involve real costs. Do you agree?"

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**Treatment of transfers (e.g. SSI Payments) depends on perspective**

- **Perspective Employed**
  - Patient
  - Health Care Agency
  - State Government
  - Federal Government
  - Taxpayer
  - Societal

- **Treatment of Transfers**
  - Benefits (negative costs)
  - None
  - State supplement plus admin costs
  - Federal SSI plus admin costs
  - Total transfer plus admin costs
  - Admin costs

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Profits

- Suppose better statin therapy lowers use of profitable angioplasty in community hospitals. Do we count the full savings from angioplasty reduction?
- Example: statin therapy as substitute for angioplasty. PS < PA
  - Suppose P_S = MC_S
  - Suppose P_A > MC_A, hospital profits used to cross-subsidize charity care
  - Then savings are
    \[ B_S - C_S - (B_A - C_A) \]
    \[ = W^*(H(S,MC_S) - H(A,PA)) - (MC_A - PA) - V(PA - MC_A) \]
  - Savings decreased by however much we value profit in its use

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Use of resources outside market

- If inputs not purchased, must estimate “price”
  - Cost of informal care
  - Donated resources
  - Volunteer time
- Price at opportunity cost – what if you had to pay for it?
- But, true cost is the opportunity cost
  - Consider why they volunteer:
    - if for fun then value benefit of fun
    - If semi-compulsory then just consider cost
Costing Drugs
A discussion