Cost-Benefit Analysis

131 Undergraduate Public Economics
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OUTLINE

Chapter 8

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DEFINITION

Cost–benefit analysis The comparison of costs and benefits of public goods projects to decide if they should be undertaken.

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Costs and Benefits of Highway Construction

		Quantity	Price/Value	Total
Costs	Asphalt	1 mill bags		
	Labor	1 mill hours		
	Repairs	$10 million (yearly)		
Benefits	Time saved	500k hours (yearly)		
	Lives saved	5 lives (year)		

- What are the costs and benefits of the project? In the first year? Over time?

MEASURING CURRENT COSTS

Cash-flow accounting: Accounting method that calculates costs solely by adding up what the government pays for inputs to a project, and calculates benefits solely by adding up income or government revenues generated by the project.

Opportunity cost: The social marginal cost of any resource is the value of that resource in its next best use.

MEASURING CURRENT COSTS

General rule: Economic costs are only those costs associated with diverting the resource from its next best use

Perfectly Competitive Markets
Social Cost = Price (true for labor and material)

Imperfectly Competitive Markets
A. Monopoly: (suppose asphalt is produced by monopoly)
Price = Marginal cost + Monopoly Marginal Profit > Marginal cost
On efficiency grounds, Social cost = Marginal cost
Profit is a transfer from government (taxpayers) to monopoly (this matters for redistribution but not efficiency)

B. Labor market with unemployment: Suppose a minimum wage set at $10 creates involuntary unemployment
The unemployed would be willing to work for $6 on average but cannot find jobs
Govt provides jobs paying $10/hour. Hired unemployed get a surplus of $4/hour.
Social Cost = $6 = $10 (wage) - $4 (surplus value of jobs for workers)

MEASURING FUTURE COSTS

Present discounted value (PDV): A dollar next year is worth $1+r$ times less than a dollar now because the dollar could earn r in interest if invested.

Maintenance cost of F in perpetuity as PDD of

$$\frac{F}{1+r} + \frac{F}{(1+r)^2} + \frac{F}{(1+r)^3} + ... = \frac{F}{r}$$

Government uses public debt with interest r to borrow (example: $r = 6\%$ nominal, r-inflation=3%)

Using debt r makes sense for short-run projects but not necessarily for long-run

Problematic predictions for the long-run: r=3% $\Rightarrow$ \$1 in 100 years $= 1/(1+r)^{100} =$ \$.052 today $\Rightarrow$ Long-run costs (such as global warming) are heavily discounted

LONG-RUN SOCIAL DISCOUNTING

Social discount rate: The appropriate value of r to use in computing PDV for social investments.

2 reasons for discounting \$1 in future relative to \$1 today

1) Absolute discounting: people prefer \$1 now than \$1 in one year. But on ethical grounds, not clear why we should do absolute discounting of future generation relative to current generation (except for meteorite end of world risk)

2) Economic growth makes future generations richer so \$1 extra means less for them than for us $\Rightarrow$ Even with zero absolute discounting, we want to discount future.

In ideal world those two effects are embodied in interest rate r so we just need to take current r to discount

LONG-RUN SOCIAL DISCOUNTING

Problem is that we don't know how growth (and hence r) are going to evolve over next 100 years

If economy collapses due to global warming, future people will be poor and we don't want to discount Example:

Zero growth: 50% probability: $r = 0\%$: \$1 in 100 years = \$1 now

Normal growth: 50% probability: $r = 3\%$: \$1 in 100 year = \$.052 now

\$1 in 100 years worth on average now: $.5 \cdot \$1 + .5\$ \cdot .052 = \$.552$

Implied discount rate $\bar{r}$ such $(1 + \bar{r})^{-100} = .552 \Rightarrow \bar{r} = .6\%$

$\Rightarrow$ We should use low discounting for distant future is there is a chance that growth will stop (Weitzman 1998)

8.1

Costs and Benefits of Highway Construction: Filling in Costs

		Quantity	Price/Value	Total
Costs	Asphalt	1 mill bags	$100/bag	100
	Labor	1 mill hours	½ at 20, ½ at 10	15
	Repairs	$10 million (yearly)	7% discount rate	43
Benefits	Time saved	500k hours (yearly)		
	Lives saved	5 lives (year)		

VALUING DRIVING TIME SAVED

1.Using Market-Based Measures to Value Time: Wages

If individuals optimize their labor supply decision, each individual is indifferent between working one hour more and getting paid its wage $\Rightarrow$ hourly wage = value of one extra hour of leisure
$\Rightarrow$ The value of saving time can be measured using wages (whether people use the saved time to work more or enjoy more leisure)

This theoretical proposition runs into some problems in practice:

1) Individuals may not be able to freely trade off leisure and hours of work; jobs may come with hours restrictions

2) One hour sitting in traffic is worse than losing one hour of leisure $\Rightarrow$ value of reducing traffic higher than time saved

Using Survey-Based Measures to Value Time: Contingent Valuation

Contingent valuation: Asking individuals to value an option they are not now choosing or do not have the opportunity to choose.

Only feasible method to value situations where there is no market price: Value of saving endangered species, keeping the Arctic pristine, etc.

Popular among environmentalists to argue that causes were worthy

The Problems of Contingent Valuation

The structure of contingent valuation surveys can lead to widely varying responses (Diamond and Hausman)

Examples of issues:

0) People don't have to pay so they can easily exaggerate value

1) Isolation of issues matters (asking 1 thing vs many)

2) Order of issues matters

3) The "embedding effect" matters (preserving 1 lake, vs 3 lakes)

Can only make rational allocation decision by looking at all the issues at the same time: allocate a budget among all causes.

Government is best placed to make this allocation.

Asking people cause by cause does not make sense for evaluating benefits for public policy decisions

Using Revealed Preference to Value Time

Revealed preference: Letting the actions of individuals reveal their valuation (also called hedonic approach)

Examples:

1) How much people are willing to pay to avoid queues: gas price controls of 1970s generated queues but small mom and pop stations exempted from price controls (could charge more and had smaller queues): can compare the difference in prices relative to queue length:

Save \$10 by queuing 1 hour $\Rightarrow$ 1 hour is worth \$10

2) How much people are willing to pay for fast highway lanes (e.g., FasTrak lanes in Bay Area)

In all cases, it is not just time saved, but avoiding unpleasant queuing or traffic

These studies estimate the value of time for the marginal person (i.e. the person indifferent between paying vs. spending time) not necessarily the same as the average person

VALUING SAVED LIVES

Valuing human lives is the single most difficult issue in cost-benefit analysis and raises ethical issues

However, virtually any government expenditure has some odds of saving a life (e.g., making roads safer, health care, etc.)

$\Rightarrow$ we need to be able to place some value on a statistical human life.

Contrast between statistical life (fewer accidents) and a real life (one specific person at risk): Possible to set a value on a statistical life but not on a real life

VALUING SAVED LIVES

Revealed Preference: As with valuing time savings, the method preferred by economists for valuing life is to use revealed preferences. We can value life by estimating how much individuals are willing to pay for something that reduces their odds of dying.

Compensating differentials: Additional (or reduced) wage payments to workers to compensate them for the negative (or positive) amenities of a job, such as increased risk of mortality (or a nicer location).

Example: bonus of $10K needed to recruit soldiers during Afghanistan-Irak wars (relative to peacetime). Afghanistan-Irak wars carries an extra 1/1000 odd of dying ⇒ Value of life would be $10K/.001=$10m

Limitations: Requires people to be rational and measures value of life for marginal person

US studies show that revealed value of life is $9.3 million on average currently

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Government Revealed Preference?

Regulation Concerning	Year	Agency	Cost per life
Childproof lighters	1993	CPSC	0.13
Food labeling	1993	FDA	0.5
Reflective devices for trucks	1999	NHTSA	1.2
Asbestos	1972	OSHA	7.2
Value of statistical life			**9.3**
Benzene	1987	OSHA	28.2
Asbestos ban	1989	EPA	99.9
Solid waste disposal	1991	EPA	128.1
Cattle Feed	1979	EPA	217.7

Trading-off time saved and value of life: speeding limits

Speeding limits reduce traffic fatalities but increase travel time

Ashenfelter and Greenstone JPE'04 analyze speed limits:

In 1987, the federal government allowed states to raise the speed limit from 55 mph to 65 mph in rural highways $\Rightarrow$ 21 states adopted higher speed limit

The 65 mph limit increased speeds by approximately 3.5%, and increased fatality rates by roughly 35% $\Rightarrow$ 125,000 hours of travel time were saved per lost life

Valuing the time saved at the average hourly wage implies that adopting states were willing to accept risks that resulted in a savings of $1.54 million (1997$) per fatality

$\Rightarrow$ Those states were valuing a life saved at $1.54 million at most

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Putting It All Together

		Quantity	Price/Value	Total
Costs	Asphalt	1 mill bags	$100/bag	$100
	Labor	1 mill hours	½ at $20, ½ at $10	15
	Repairs	$10 million (yearly)	7% discount rate	43
Benefits	Time saved	500k hours (yearly)	$19/hour	9.5
	Lives saved	5 lives (year)	$7 million/life	35

OTHER ISSUES IN COST-BENEFIT ANALYSIS

Common Counting Mistakes: When analyzing costs and benefits, a number of common mistakes arise, such as:

-Counting secondary benefits (e.g., more commerce activity around new highway comes at the expense of other places)

-Counting labor as a benefit (e.g., labor is a cost, jobs created means those workers do not produce something else)

-Double-counting benefits (e.g., rise in house values due to reduced commuting time)

Distributional Concerns: The costs and benefits of a public project do not necessarily accrue to the same individuals.

Uncertainty: The costs and benefits of public projects are often highly uncertain.

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