Cost-Benefit Analysis

131 Undergraduate Public Economics

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OUTLINE

Chapter 8

8.1 Measuring the Costs of Public Projects

8.2 Measuring the Benefits of Public Projects

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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.

Measuring the Costs of Public Projects

The Example

TABLE 8-1

Cost-Benefit Analysis of Highway Construction Project

		Quantity	Price / Value	Total
Costs	Asphalt	1 million bags		
	Labor	1 million hours		
	Maintenance	$10 million/year		
			First-year cost:	
			Total cost over time:	
Benefits	Driving time saved	500,000 hours/year		
	Lives saved	5 lives/year		
			First-year benefit:	
			Total benefit over time:	
			Benefit over time minus cost over time:	

The renovation of the turnpike in your state has three costs: asphalt, labor, and future maintenance. There are two associated benefits: reduced travel time and reduced fatalities. The goal of cost-benefit analysis is to quantify these costs and benefits.

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 govt (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.
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.

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

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

Problematic predictions for the long-run: r=3% $\Rightarrow$ \$100 in 100 years $= 1/(1+r)^{100} =$ \$5.2 today $\Rightarrow$ Long-run costs (such as global warming) are heavily discounted

LONG-RUN SOCIAL DISCOUNTING

2 reasons for discounting \$1 in distant 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 (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

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. This implies we should use low discounting for distant future (Weitzman)

Measuring the Costs of Public Projects

Measuring Future Costs

TABLE 8-2

Cost-Benefit Analysis of Highway Construction Project

		Quantity	Price / Value	Total
Costs	Asphalt	1 million bags	$100/bag	$100 million
	Labor	1 million hours	½ at $20/hour and ½ at $10/hour	$15 million
	Maintenance	$10 million/year	7% discount rate	$143 million
			First-year cost:	**$115 million**
			Total cost over time (7% discount rate):	**$258 million**
Benefits	Driving time saved	500,000 hours/year		
	Lives saved	5 lives/year		
			First-year benefit:	
			Total benefit over time:	
			Benefit over time minus cost over time:	

The cost of the asphalt for this project is dictated by the market price for asphalt, $100 per bag. The cost of labor depends not on the wage but on the full opportunity cost of the labor, which incorporates the current unemployment of any workers who will be used on the project. The cost of future maintenance is the present discounted value of these projected expenditures.

VALUING DRIVING TIME SAVED

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

If individuals optimize their labor supply decision: at the margin, 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) Wage should include not only cash wage paid to worker but also fringe benefits (total hourly compensation cost)

3) 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:

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

You also 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. Many would say that human life is priceless, that we should pay any amount of money to save a life. By this argument, valuing life is a reprehensible activity; there is no way to put a value on such a precious commodity.

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

To escape the impotence that would be imposed by the "life is priceless" argument, one needs 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

APPLICATION

Valuing Life

The sticky ethical problem of valuing life arises in many instances in public policy, as shown by these examples.

1. In 1993, consumer groups demanded that General Motors recall about 5 million pickup trucks it had manufactured between 1973 and 1987. This recall would cost $1 billion and would, according to government calculations, save at most 32 more lives (since the trucks were slowly falling out of use). Using these estimates, the cost per life saved by the recall would have been $1 billion/32 = $31.25 million.

2. In October 1999, a commuter train crash at London's Paddington Station killed 31 people and prompted calls by an outraged public for more investment in rail safety measures. At best ($3 billion to save three lives per year for 50 years), this would mean spending $20 million per life saved; at worst ($9 billion to save one life per year for 30 years), it would mean $300 million per life saved.

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: bonuses needed to recruit soldiers during Afghanistan-Irak wars

US studies show that revealed value of life is $7.6 million

Measuring the Benefits of Public Projects

Valuing Saved Lives

Government Revealed Preference

TABLE 8-3

Costs Per Life Saved of Various Regulations

Regulation concerning . . .	Year	Agency	Cost Per Life Saved (millions of 2005 $)
Childproof lighters	1993	CPSC	$0.1
Food labeling	1993	FDA	0.4
Reflective devices for heavy trucks	1999	NHTSA	1.0
Children's sleepwear flammability	1973	CPSC	2.4
Rear/up/shoulder seatbelts in cars	1989	NHTSA	4.8
Asbestos	1972	OSHA	6.0
VALUE OF STATISTICAL LIFE			**7.6**
Benezene	1987	OSHA	24
Asbestos ban	1989	EPA	85
Cattle feed	1979	FDA	185
Solid waste disposal facilities	1991	EPA	109,000

Morrall (2003), Table 2, updated to 2005 dollars.

Government safety regulations increase costs and save lives, and these costs and benefits can be compared to compute an implicit cost per life saved. These values range from a low of $110,000 per life saved for childproof lighters to a high of over $109 billion per life saved for solid waste disposal facility regulations.

Putting It All Together

■ TABLE 8-4

Cost-Benefit Analysis of Highway Construction Project

		Quantity	Price / Value	Total
Costs	Asphalt	1 million bags	$100/bag	$100 million
	Labor	1 million hours	½ at $20/hour and ½ at $10/hour	$15 million
	Maintenance	$10 million/year	7% discount rate	$143 million
			First-year cost:	**$115 million**
			Total cost over time (7% discount rate):	**$258 million**
Benefits	Driving time saved	500,000 hours/year	$17/hour	$8.5 million
	Lives saved	5 lives/year	$7 million/life	$35 million
			First-year benefit:	**$43.5 million**
			Total benefit over time (7% discount rate):	**$621.4 million**
			Benefit over time minus cost over time:	**$363.4 million**

The time savings from this project is most appropriately valued by the revealed preference valuation of time, which is $17/hour. The life savings is most appropriately valued by the revealed preference value of life, which averages $7 million. The present discounted value of costs for this renovation project is $258 million, while the *PDV* of benefits for this project is $621.4 million. Because benefits exceed costs by $363.4 million, the project should clearly be undertaken.

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 cost)

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.

CONCLUSION

Government analysts at all levels face a major challenge in attempting to turn the abstract notions of social costs and benefits into practical implications for public project choice.

What at first seems to be a simple accounting exercise becomes quite complicated when resources cannot be valued in competitive markets.

Nevertheless, economists have developed a set of tools that can take analysts a long way toward a complete accounting of the costs and benefits of public projects.