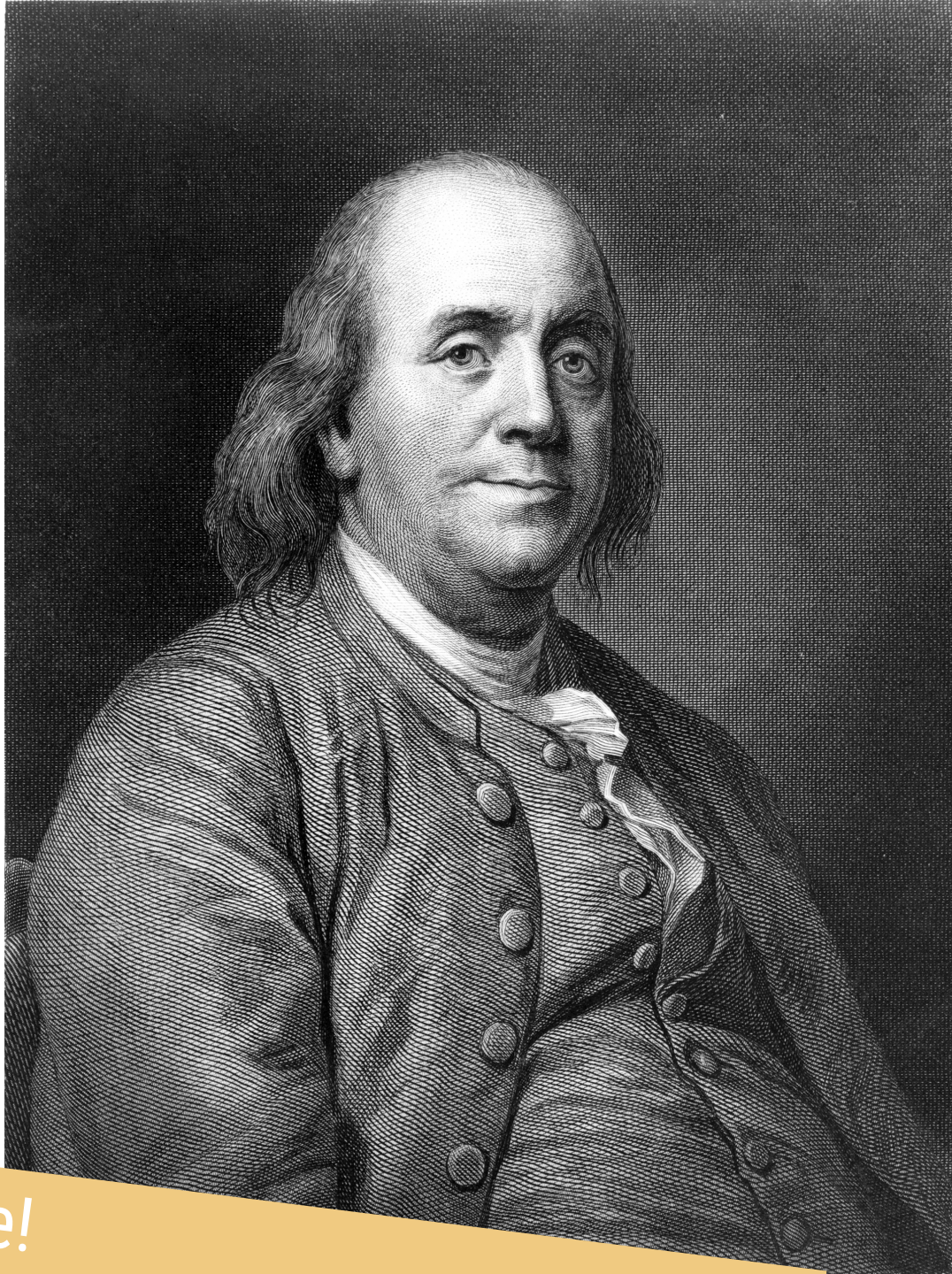
Cost-benefit analysis I

MPA 612: Public Management Economics

March 26, 2018



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Plan for today

What is CBA?

Nine steps of CBA

CBA practice

Current events

What is CBA?

My way is to divide half a sheet of paper by a line into two columns; writing over the one Pro and over the other Con.… When I have thus got them altogether in one view, I endeavor to estimate their respective weights; and where I find two, one on each side, that seem equal, I strike them both out.… [T]hus proceeding, I find where the balance lies; and if after a day or two of further consideration… , I come to a determination accordingly.

Benjamin Franklin

At its core, CBA is just Franklin's pro/con list, but for society

Easy logic

Net social benefit = benefits – costs

Difficult implementation

Measurement

What counts?

Easy to hide behind numbers

Ultimately involves a normative judgement

Subject to abuse

The cost of building dams is always underestimated
There's erosion of the delta that the river has created,
There's fertile soil below the dam that's likely to be looted,
And the tangled mat of forest that has got to be uprooted.

There's the breaking up of cultures with old haunts
    and habits loss,
There's the education program that just doesn't come across,
And the wasted fruits of progress that are seldom much enjoyed
By expelled subsistence farmers who are urban unemployed.

There's disappointing yield of fish, beyond the first explosion;
There's silting up, and drawing down, and watershed erosion.
Above the dam the water's lost by sheer evaporation;
Below, the river scours, and suffers dangerous alteration.

Kenneth E. Boulding, The Careless Technology (1973)

For engineers, however good, are likely to be guilty,
Of quietly forgetting that a river can be silty,
While the irrigation people too are frequently forgetting
That water poured upon the land is likely to be wetting.

Then the water in the lake, and what the lake releases,
Is crawling with infected snails and water-borne diseases.
There's a hideous locust breeding ground when water level's low,
And a million ecologic facts we really do not know.

There are benefits, of course, which may be countable, but which
Have a tendency to fall into the pockets of the rich.
While the costs are apt to fall upon the shoulders of the poor.
So cost-benefit analysis is nearly always sure.
To justify the building of a solid concrete fact,
While the Ecologic Truth is left behind in the Abstract.

Brief history of CBA in government

1936: Army Corps of Engineers

1950s–70s: Experimentation

1981: Reagan’s EO 12291 and RIA

1994: Clinton’s EO 12866

Types of CBA

ex ante

in medias res

ex post

Who uses CBA?

Executive agencies

Legislators

Courts

Nonprofits

CBA is deceptively hard and complicated and expensive in real life

Nine steps of CBA

Easy peasy!

1. Specify the set of alternative projects

2. Decide whose benefits and costs count

3. Identify impacts and measure them

4. Predict the impacts quantitatively over the life of the project

5. Monetize all impacts

6. Discount benefits and costs to obtain present values

7. Compute the net present value of each project

8. Perform sensitivity analysis

9. Make a recommendation

1. Specify the set of alternative projects

List all the possible alternatives

Keep status quo if still viable

Asphalt or concrete

4 different routes

2, 3, 4, or 6 lanes

No tolls, low tolls, high tolls

Elk tunnels?

Begin construction now or later

2. Decide whose benefits and costs count

Standing

Just citizens of city/state/country?

Just people currently alive?

3. Identify impacts and measure them

Impacts = inputs and outputs

Think of every possible thing involved

You live in a city that currently does not require bicycle riders to wear helmets. You like riding your bicycle without a helmet.

From your perspective and society's perspective, what are the major costs and benefits of a proposed city ordinance that would require all riders to wear helmets?

How might you measure these?

4. Predict the impacts quantitatively over the life of the project

Make predictions for each of the impacts from step 3

Figure out number of vehicle trips on new highway + old roads

Extrapolate and estimate driving costs saved, accidents avoided, lives saved, etc.

5. Monetize all impacts

Put everything in the same scale: $$$

Market prices

Shadow prices

Statistical life ≠ individual life

What did Colbert claim?
What was wrong?

Value of a statistical life
How much people are willing to pay for a reduction in the probability of death, extrapolated to 100%

Contingent evaluation

Ask people what they'd be willing to pay to lower risk

Surveys, focus groups, guesses

Revealed preferences

Look at what people pay in real life

Low risk jobs pay less than high risk jobs, so higher wage = WTP for reduction in risk

Contingent evaluation vs. revealed preferences

We tend to trust people's own revealed safety vs. money preferences

But, it's tricky

Monthly Labor Review
mlr
BLS

ARTICLE

OCTOBER 2013

Using data from the Census of Fatal Occupational Injuries to estimate the "value of a statistical life"

The advent of the Census of Fatal Occupational Injuries has enabled researchers to reduce measurement error in fatality rate estimates; in turn, estimates of the "value of a statistical life" that are based on labor market data have become less uncertain.

Table 1. Fatality rates, by industry and occupation, 2006–2008

Occupation	Industry										
	Total	Construction	Finance, insurance, and real estate	Information	Manufacturing	Mining	Public administration	Retail trade	Services	Transportation and public utilities	Wholesale trade
Management, business, and financial	1.2	3.8	0.8	0.6	0.7	3.2	0.9	0.7	1.1	1.3	1.5
Professional and related	.9	3.5	.2	1.1	.7	7.2	1.2	.7	.8	1.5	1.3
Service	3.2	16.2	2.8	2.0	1.9	(1)	9.1	2.1	2.4	2.9	(1)
Sales	1.9	1.9	1.1	2.1	1.7	(1)	(1)	2.3	1.1	1.0	2.1
Office and administrative support	.5	.6	.3	.4	.4	(1)	.3	.6	.4	1.4	.5
Farming, fishing, and forestry	8.3	(1)	(1)	(1)	6.7	(1)	10.3	8.6	19.4	15.5	4.6
Construction and extraction	12	11.8	4.8	(1)	6.6	34.9	5.0	3.1	12.4	8.4	8.4
Installation, maintenance, and repair	6.9	13.8	6.2	3.6	6.0	16.5	1.9	3.0	6.2	8.9	11.7
Production	2.8	14.1	3.2	2.0	2.4	16.1	2.8	1.1	2.8	4.1	7.0
Transportation and material moving	15.8	21.6	15.3	28.2	7.9	25.4	13.9	5.7	14.1	22.4	11.4
Industry average	…	10.2	1.0	1.7	2.4	20.7	3.9	2.1	1.8	11.5	4.0

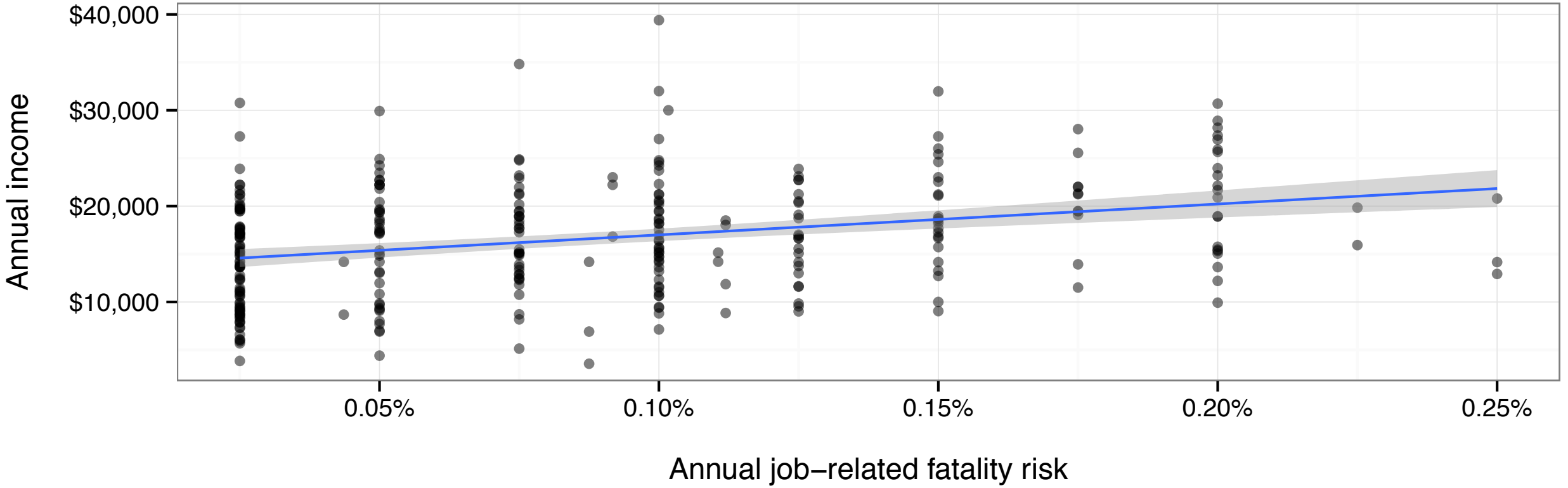
$40,000
$30,000
$20,000
$10,000
Annual income
0.05%
0.10%
0.15%
0.20%
0.25%
Annual job−related fatality risk

Table 3. Regression estimates of the value of a statistical life

Category	Wage equation, based on—		Logarithm of wage equation, based on—	
	Hours-based fatality rates	Employment-based fatality rates	Hours-based fatality rates	Employment-based fatality rates
Fatality rate	0.0395 (0.0078)	0.0437 (0.0067)	0.0024 (0.0003)	0.0026 (0.0003)
Value of a statistical life (in millions of dollars)	7.9	8.7	9.9	11.1
Adjusted *R*-squared	.3884	.3885	.4405	.4407

Note: Standard errors are in parentheses following the estimate. All coefficients are statistically significant at the 99-percent level or better. Endnote 5 in the text gives other variables included in the equation. The sample size is 126,225.

Source: Author's calculations, based on U.S. Bureau of Labor Statistics, Current Population Survey.

potential work experience + potential work experience squared + years of education + indicator variables for male, married, Black, Native American, Asian, Hispanic ethnicity, doctorate or professional degree earned, paid hourly rate, full-time employment, union or employee association membership, government employment, six metropolitan and nonmetropolitan areas, eight regional areas, nine largely blue-collar occupations, and professional occupational group

Coefficient × 100,000 × average hours worked per year

0.0395 × 100,000 × (42.57 × 52) = $8.74 million

Off because of rounding

Others, like NHTSA

6. Discount benefits and costs to obtain present values

Present value = value of an amount that occurs in the future

$$PV = \frac{FV}{(1+r)^t}$$

Why even do this?

Costs of public projects are front loaded

Benefits occur over a long period of time

How do we know if the benefits over time are worth the initial costs?

Discount rates

Opportunity costs

Time value of money

OMB Circular A-94 Appendix C

1%, 3%, 7%, then sensitivity analysis

World Bank uses 10%

7. Compute the net present value of each project

$$PV = \frac{FV}{(1+r)^t}$$

$$TPV = \sum_{t=0}^{n} \frac{X_t}{(1+r)^t}$$

$$NPV = TPV(\text{benefits}) - TPV(\text{costs})$$

8. Perform sensitivity analysis

Manipulate or simulate everything that is uncertain or contentious

Impacts

VSL

Monetizations

Discount rate

9. Make a recommendation

If NPV > 0,

Important CBA numbers

Benefit cost ratio (BCR):
Total benefits / Total cost

Internal rate of return (IRR):
Breakeven discount rate

Net present value (NPV):
Benefits – costs

CBA practice

Excel time!