Some remarks on valuation in accounting

David Simpson*

rdsimpson3@live.com

*All opinions expressed here are my own, and do not necessarily reflect the position of the United States Environmental Protection Agency

Outline

- A few remarks on what accounting is intended to show
- Underscore difficult of valuing investments in natural capital in the absence of markets.
- Give an example in which values may change substantially, depending on a number of location-specific factors.
- Conclusion: we really have our work cut out for us if we're going to come up with *accurate, comprehensive*, and *large-scale* accounts; are we willing to relax on any of those margins?

A schematic approach to green accounting

- Economists think about utility:

$$U(x_1, x_2, \ldots, x_N)$$

- We also think "on the margin"
  - —We can't say what everything is worth,
  - —Nor can we say what anything is worth, except by making some comparison to how much of something else you'd give up for it.
- So we can think about changes in utility as:

$$dU = \partial U/\partial x_1 \cdot dx_1 + \partial U/\partial x_2 \cdot dx_2 + \ldots + \partial U/\partial x_N \cdot dx_N$$

- Divide by one of those marginal utilities . . . .

$$dU/MU_1 = dx_1 + (MU_2/MU_1)\cdot dx_2 + \ldots + (MU_N/MU_1)\cdot dx_N$$

- Apply the first thing we learned in econ 101, and *voila*!

$$dU/MU_1 = dx_1 + P_2\cdot dx_2 + \ldots + P_N\cdot dx_N :$$

- The period-by-period change in the value, at market prices, of the stuff we consume, measures how much our well-being has gone up.
- Of course we all know it isn't, though. Among its many other flaws it doesn't reflect
  - — Capital consumption; and
  - — Nonmarket goods

Capital

- The first of the omissions is easier to deal with if there are markets for capital
- The period-on-period change in consumption will be misleading if by consuming more today we're diminishing the consumption we can enjoy later.
- When capital goods are traded in markets, though, there's a simple and intuitive way of including them in national accounts; it goes like this:
  - — Whatever capital investment (or disinvestment) we make now pays off by giving us $\Sigma\, MU \cdot MP_K / (1 + \delta)^t$
  - —And, if we're optimally deciding between consuming and investing, the value of that capital investment is just equal to the marginal utility of whatever consumption we gave up to make it.

The harder part: nonmarket goods

- If stuff is traded in markets, even if we can't observe *MU*'s, we can assume that their ratios are reflected in prices.
- By definition, nonmarket goods have no prices, so we need to try to guesstimate the *MU* they afford.
- That's where the various methods of nonmarket valuation come in:
  - —Recreation demand modeling
  - —Hedonic pricing
  - —Contingent valuation/choice experimentation, etc.
- We can take such "prices" and use them to augment the year-on-year consumption changes.
  - — May have to be careful about double-counting
  - — We may have some tricky distinctions between current and capital accounts (e. g. current enjoyment as reflected in housing rent vs. enhanced capital value reflected in housing price)

The hardest part: natural capital

- Because *natural* capital, unlike manufactured capital, is not bought and sold in markets, we
  - — Do not observe a market price of capital; and
  - — Cannot assume an optimal choice between consumption now and investment for the future.
- So, we have to estimate
  - —The marginal utility arising from the additional consumption the investment affords; and
  - —The marginal product of that investment; for
  - —All eternity.
- And none of that is going to be easy!

From very general to quite specific: An example of an ecosystem service

One of the services we often hear about is “waste treatment”:

Un- or less-disturbed land in forests, grasslands, and wetlands can

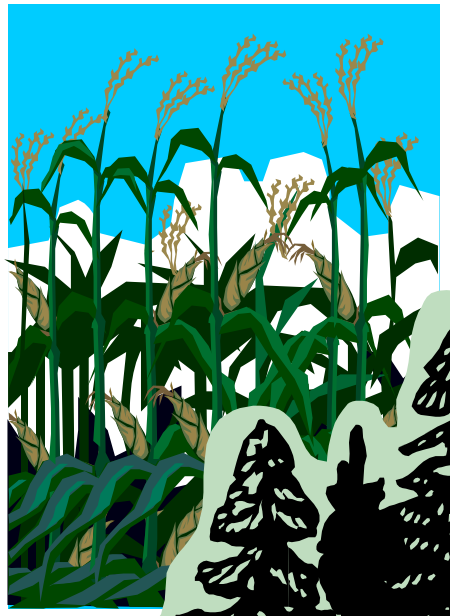
- —Slow the flow of surface water, which may itself lead to settling or degrading of pollutants;
- —Vegetation may filter and remove pollutants;
- —Such systems may also encourage infiltration of water.

Empirical work supports a common-sense conjecture: pollutant load would decline as

$$\partial L/\partial x = -\phi L;$$

a constant fraction, ϕ, of the pollution load, L, is reduced per unit of linear distance traveled, x.

Farm generates a quantity L_0 of nutrient runoff



Runoff is filtered through a forest area of extent x

Delivered runoff load is $L_0e^{-\phi x}$, which causes damage $D(L_0e^{-\phi x})$

Other assumptions aren't going to yield very different results:

Some load is going to be filtered for every unit system devoted to the service; and

We can't filter out more pollution than is left to be eliminated.

The previous assumption implies that

$$L = L_0 e^{-\phi x}$$

Suppose that received pollution of L results in damages of $D(L)$.

What is the additional damage associated with the loss of the marginal hectare of forest (or wetland, or whatever) ecosystem?

$$D' \cdot L_0 \, \phi \, e^{-\phi x}.$$

A few observations on the value of this ecosystem service

- As in real estate, three things matter:
  - Location;
  - Location; and
  - Location
- What can differ by location?
  - Marginal damage, D';
  - Initial load, L_0;
  - Efficacy of treatment, ϕ; and
  - Extent of ecosystem being valued, x.

More observations . . .

- The marginal value of the ecosystem service vanishes if
  - x is large; this is just the diamonds-and-water paradox.
  - If $x > 0$ and ϕ is large; call this the "a little can go a long way" effect.
  - If L_0 is small; the waste treatment service is only valuable if there are wastes to treat.
  - If D' is substantial; receiving waters can't be too clean – or too dirty.
- We can make some limiting bounding assumptions; e. g.,

$$D' \cdot L_0 \phi e^{-\phi x} \leq D' \cdot L_0 / xe,$$

but informational requirements will still be extreme.

A very, very, very rough example

- Suppose gross reactive nitrogen pollution from Chesapeake Bay farms were 100 million pounds/year.
- About 20% of the land area in the Chesapeake watershed is in farms; that's about 13,000 square miles.
- There are about 120,000 miles of streams in the watershed
- Suppose the density of stream miles is same in farmland as overall for the watershed $\Rightarrow$ about 24,000 miles of streams $\Rightarrow$ about $L_0 \approx 4{,}000$ pound of rN per stream mile.

What would be the value of an extra foot of riparian buffer?

Suppose buffers are 50 feet (roughly 15 meters) wide, and set ϕ = 0.02 ft^{-1} to maximize marginal value

$$D' \, L_0 \, \phi e^{-\phi x} = D' \, 4{,}000 \cdot 0.02 e^{-0.02 \cdot 50} \approx D' \cdot 30.$$

How sensitive is this to parameters?

Fix x and make ϕ 0.01 (half as effective): $D' \cdot 24$

ϕ 0.04 (twice as effective): $D' \cdot 22$

Fix ϕ and make x 25 (half as wide): $D' \cdot 50$

x 100 (twice as wide): $D' \cdot 11$

The opportunity cost of an additional foot buffer on both sides of a mile of stream is about $2500.

One very clear message from this:

- It would be really, really stupid to assign a value to the waste treatment services provided by “riparian strips,” regardless of
  - Extent
  - Location
  - Presence of pollution loads
  - Destination of pollutant loads
  - Site-specific analysis of efficacy of treatment
- Don’t laugh; people are actually doing this!

If we figure out what this ecosystem services is worth, where do we record it?

Why stop at double-counting? We could measure:

- —Damages from pollution as a function of pollution;
- —Damages from pollution as a function of reduced forest area;
- —Damages from pollution as measured in lower fish populations;
- — Damages from pollution as measured in reduced consumption.

Some concluding thoughts

- The example shows that there are limits to how far we can go along any of the dimensions of accounting:
  - Geographical extent
  - Sectoral inclusion
  - Statistical reliability
- What are we trying to show?
  - Just that it can be done . . . For something . . . Somewhere . . . Sometimes?
  - Or that results can and will affect outcomes?
- A depressing observation on our profession:
  - We have developed really powerful tools that do a great job of measuring outcomes . . .
  - . . . so long as nothing we can learn from the measurements can be used to improve on the outcomes.
  - Things get very difficult when we're trying to develop measurements without assuming we're already living in the best of all possible worlds.