The Connection between Natural Capital Productivity and Intergenerational Equity

Focus on Ecosystem Services

Ecosystem Services Workshop
Baltimore, Maryland
June 30, 2012

Laurel Pentelow – University of Ottawa, Canada
Natural capital = land, natural resources (renewable and non renewable) and ecosystem services

Presentation Outline
- Research Rationale – Intergenerational Equity
- Key concepts
- Productivity and Natural Capital
- Economic Valuation + ecosystem services (opportunities and challenges)
- Conclusions
Current rates of production are degrading the environment

A degraded environment is a problem for intergenerational equity

More specifically, degraded natural capital is a problem for potential future economic productivity
Concepts - Productivity

- Productivity measures the relationship between the inputs in a production process and the output of economic activity
  \[
  \text{Productivity} = \frac{\text{output}}{\text{input}}
  \]

- Measure of productivity is extremely important for an economy when looking at long-term economic growth\(^2\)

- Changes in productivity are related to changes in standards of living
Original (and still consistently used) measure of productivity is labour (output divided by number of hours worked)$^3$

More recent productivity measure is multifactor (output divided by all inputs – labour, capital, energy, services etc)$^4$

While moving to compare total output against total inputs is an improvement, this still neglects natural capital (and therefore provides an inaccurate picture of the state of the economy)
Definition of traditional capital:
- a stock of instruments existing at an instant in time
- a stream of services through time, flowing from this stock of wealth
- Reproducible by humankind

Does this definition work for natural capital?
Definition of traditional capital:
- a stock of instruments existing at an instant in time ✔
- a stream of services through time, flowing from this stock of wealth ✔
- Reproducible by humankind ✗

New, more general capital definition works better with idea of natural capital is

“any stock that yields a flow of valuable goods or services into the future”

5
As already noted, natural capital is here defined as being made up of

- Natural resources (renewable and non-renewable)
- Ecosystem services
- Land

Together these make up natural capital, but it is also important to study them independently
Link between current and future natural capital use

- Production Process
- Ecosystem
- Non-Salable Output (i.e. pollution)
- Salable Outputs
- Non-marketed Input (i.e. filtration services)
- Labour
- Capital
- Energy
- Water
Consequences of Current Economic Production

- Current degradation of natural capital leads to lower potential future productivity

- This likely also means a lower maximum standard of living level (at odds with goals of intergenerational equity)

- Solutions???
Possible Solutions

- Typically, environmental regulations have been the solution to environmental damage
- Lower productivity is seen as an inevitable result of these measures
  - Justifiable fear because increasing costs without increasing outputs does reduce productivity
- Result is that industry often rallies against environmental regulation
Environmental regulation only lowers productivity under traditional – and incomplete – productivity measures.

Like GDP and others, traditional productivity does not include values of non-marketed natural capital.

If it did, environmental regulation could be seen as productivity boosters.
Traditional vs. Adjusted Productivity Measure

- **Traditional**
  \[
  \text{Productivity} = \frac{\text{salable outputs}}{\text{market-valued inputs}}
  \]

- **Adjusted**
  \[
  \text{Productivity} = \frac{\text{salable outputs} - \text{non-salable outputs}}{\text{market-valued inputs} + \text{non-market valued inputs}}
  \]
How do we get these values?

- In order to be able to use this formula we must have values for non-salable outputs and non-marketed inputs

- Economic valuation of natural capital and ecosystem services is the key
The Valuation Challenge

- Should we place monetary values on nature?
- Different uses of natural capital that need to be valued (not just one value, but a combination)
- Natural resources + land tend to be easier to value, ecosystem services are generally much more difficult
# Economic Valuation of Ecosystem Services

## Natural Capital Uses/Non Uses

<table>
<thead>
<tr>
<th>Use</th>
<th>Direct Use</th>
<th>Consumptive</th>
<th>Harvesting Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non Consumptive</td>
<td>Recreation, Tourism</td>
</tr>
<tr>
<td>Indirect Use</td>
<td></td>
<td>Wetland Filtration Process</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-Use</th>
<th>Existence</th>
<th>Knowledge that aspect of nature exists</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bequest</td>
<td>Knowledge that aspect of nature will still exist for future generations</td>
</tr>
<tr>
<td></td>
<td>Option</td>
<td>Knowledge that aspect of nature will exist if you decide to visit or make use in the future</td>
</tr>
</tbody>
</table>

- **Market Values** (e.g. Stumpage fee)
- **Travel Cost Method**, **Hedonic Pricing Method**
- **Comparison to Cost of Substitute, Contingent Valuation**
- **Contingent Valuation**, **Debt-for-Nature Swaps**
- **Contingent Valuation**
- **Contingent Valuation**

The process of benefits transfer can be very useful in valuation studies.
The implementation of a modified productivity calculation (including natural capital) should allow governments to create policy and regulation aimed at improving efficient use of natural resources and the natural productivity of ecosystem services. These improvements will help achieve the goal of leaving the environment in a state no worse than it was received (and therefore allowing future generations to achieve the level of productivity – and standard of living – they desire).
Thank You

- Please contact me with any questions, suggestions or comments (lpento39@uottawa.ca)


4 Vivian Chen et al, ‘Recent Productivity Developments in the World Economy: An Overview From the Conference Board Total Economy Database’ [2010] International Productivity Monitor 19, 6


Traditional Productivity Measure

Traditional –
No Environmental Regulation

Included
Salable Outputs = + 60
Market Inputs = 30

Excluded
Non-Salable Outputs = -10
Non-Market Inputs = 10

Productivity = 60/30 = 2

Traditional –
Post Environmental Regulation

Included
Salable Outputs = + 60
Market Inputs (incl. Additional cost for meeting environmental requirement) = 40

Excluded
Non-Salable Outputs (incl. reduction in pollution as a consequence of new environmental requirement) = -5
Non-Market Inputs (incl. increase in efficiency use of natural capital – and therefore less cost – as a consequence of new environmental requirement) = 6

Productivity = 60/40 = 1.5
Adjusted – Post Environmental Regulation

Included
Salable Outputs = + 60
Non-Salable Outputs (incl. reduction in pollution as a consequence of new environmental requirement) = -5
Market Inputs (incl. Additional cost for meeting environmental requirement) = 40
Non-Market Inputs (incl. increase in efficiency use of natural capital – and therefore less cost – as a consequence of new environmental requirement) = 4

Productivity = 60-5/40+4 = 1.25

Adjusted – No Environmental Regulation

Included
Salable Outputs = + 60
Non-Salable Outputs = -10
Market Inputs = 30
Non-Market Inputs = 10

Productivity = 60-10/30+10 = 1.25