Lecture 13
Sustainability and Development

• Sustainability as a criterion
• Measuring sustainability
• Equity in the future versus now
• Environment and development

Solow’s Discussion of Sustainability

• Sustainability is a moral obligation to leave the future with at least the same capacity or opportunity to be as well off as we are.
• Interest in sustainability is a focus on different types of investment rather than consumption
• How can we be concerned about equity for the future when things are so inequitable now? The uneasiness in this is that more equity now can mean less sustainability.
• Research and knowledge is a good thing. Knowledge is an environmentally neutral asset.
Measuring Sustainability – Hartwick’s Valuation of Capital

Consider a non-renewable resource – a mine. The economic value of a mine is the present value of its extracted output.

\[
V_t = \left[ \frac{1}{1+r} \right] (pq_{t+1} - c(q_{t+1})) + \left[ \frac{1}{1+r} \right]^2 (pq_{t+2} - c(q_{t+2})) + \cdots + \left[ \frac{1}{1+r} \right]^n (pq_{t+n} - c(q_{t+n}))
\]

- \(n\) = number of years we consider
- \(p\) = constant (in real terms)
- \(c(q)\) – extraction cost – increases with output \(q\)
- \(V_t\) = selling price of mine (economic value)

The decline in the value of the mine is the value of \(q_{t+1}\) removed from stock.

\[
V_t - V_{t+1} = \text{economic depreciation of mine}
\]

\[
V_t - V_{t+1} = pq_{t+1} - c(q_{t+1}) - rV_t
\]

- \(V_t - V_{t+1}\) = economic depreciation of mine
- \(V_t - V_{t+1}\) = loss plus interest
Marginal cost of extraction

\[ V_t - V_{t+1} = (P - MC(q_{t+1})) \cdot q_{t+1} \]

Value of added deposit = Rent \( \cdot q_{t+1} \)

This is our measure of sustainability – are we adding back what we lose?

### Suggestive Calculations or Sustainability

<table>
<thead>
<tr>
<th>Country</th>
<th>Saving/GNP</th>
<th>Dep. of Man Made Capital/GNP</th>
<th>Dep. of Natural Res./GNP</th>
<th>Index of Sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>18</td>
<td>12</td>
<td>3</td>
<td>+3</td>
</tr>
<tr>
<td>Netherlands</td>
<td>25</td>
<td>10</td>
<td>1</td>
<td>+14</td>
</tr>
<tr>
<td>Japan</td>
<td>33</td>
<td>14</td>
<td>2</td>
<td>+17</td>
</tr>
<tr>
<td>U.K.</td>
<td>18</td>
<td>12</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Mexico</td>
<td>24</td>
<td>12</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Indonesia</td>
<td>20</td>
<td>5</td>
<td>17</td>
<td>-2</td>
</tr>
<tr>
<td>Nigeria</td>
<td>15</td>
<td>3</td>
<td>17</td>
<td>-5</td>
</tr>
</tbody>
</table>
Environmental Kuznets curve

What is story?
Economic growth increases income and people can “afford” improved environmental quality
• economics
• politics
• assumes reversible

Poverty and Environment

Sach’s Comparison of Asia and Africa in 1980

<table>
<thead>
<tr>
<th></th>
<th>East Asia</th>
<th>Sub-Saharan Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal Yield (kg/hectare)</td>
<td>2,016</td>
<td>927</td>
</tr>
<tr>
<td>Irrigated land (% of cropland)</td>
<td>37</td>
<td>4</td>
</tr>
<tr>
<td>Share of crop area planted to modern varieties (%)</td>
<td>43</td>
<td>4</td>
</tr>
<tr>
<td>Adult literacy rate (%)</td>
<td>70</td>
<td>38</td>
</tr>
<tr>
<td>Infant mortality rate (per 1,000 live births)</td>
<td>56</td>
<td>116</td>
</tr>
<tr>
<td>Births per woman</td>
<td>3.1</td>
<td>6.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 1: Characteristics of High, Medium, and Low Income Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characteristics</strong></td>
</tr>
<tr>
<td>Income Range</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>Occupation</td>
</tr>
<tr>
<td>Housing Type</td>
</tr>
<tr>
<td>Average Household</td>
</tr>
</tbody>
</table>

*Note: Data compiled from the 2022 Economic Census.*
Sach’s Explanation for Persistent Poverty

- Poverty as a cause of Economic Stagnation – too poor to save
- Physical geography – hard transport costs, geography of local conditions, land locked
- Infrastructure
- Government failure – secure property rights, absence of corruption
- Culture – women’s rights, ethnic cleansing, poor social norms
- Lack of innovation – education, scale, property rights.
Environment and Trade

• **Open Access Resources** – trade can expand the pace of degradation if the capacity of the resource is not reached by a domestic market; results depend on ability of “owning” country to exercise property rights

• **Understand Trade Agreements**
  – NAFTA – US, Mexico, and Canada – our key issue is the extent of pollution at the border between US and Mexico
  – GATT – General Agreement on Tariffs and Trade – executed in 1947; Uruguay Round – last meeting – signed in 1993

Environment and Trade, cont’d.

• **WTO** – formed in 1995 as successor to GATT; goals are:
  – Administer trade agreements
  – Facilitate trade negotiations and resolve disputes
  – Oversee national trade policies
  – Help developing nations in trade policy

• Only focuses on how environmental protection affects trade flows