Session 4.3 (Special Session)

An Introduction to the Economics of Climate Change and Social Cost of Carbon

Introductory Course on Economic Analysis of Investment Projects
Plan of Talk

- Climate change impacts
- How to quantify/model climate change impacts
- Social cost of carbon
- Considering climate change in project economic analysis
- Summary and issues for discussion
Climate Change Impacts
# Climate Change Impacts

## Figure H3. Potential Impacts of Climate Change on Key Sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Regional Temperature Change (relative to 1990)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1°C</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Increasing potential of crop yields in selected countries</td>
</tr>
<tr>
<td></td>
<td>Falling crop yields</td>
</tr>
<tr>
<td></td>
<td>Loss of agricultural lands due to sea level rise</td>
</tr>
<tr>
<td></td>
<td>Delay in current cropping schedule</td>
</tr>
<tr>
<td>Water Resources</td>
<td>Increasing population under water stress</td>
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<tr>
<td></td>
<td>Increased water runoff</td>
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<tr>
<td></td>
<td>Decreasing quality of aquifer and ground water resources</td>
</tr>
<tr>
<td>Forestry and Ecosystem</td>
<td>Tropical forest gradually replaced by tropical savannas and shrub lands</td>
</tr>
<tr>
<td></td>
<td>Loss of small islands</td>
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<tr>
<td></td>
<td>Biodiversity loss</td>
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<tr>
<td>Health</td>
<td>Increased respiratory and cardiovascular diseases due to thermal stress</td>
</tr>
<tr>
<td></td>
<td>Outbreak of vector born diseases (malaria and dengue)</td>
</tr>
<tr>
<td>Extreme Weather Events</td>
<td>Increased frequency and intensity of extreme weather events (heat waves and drought, flooding, and tropical cyclones)</td>
</tr>
</tbody>
</table>

Source: ADB study team, adapted from Stern (2007).
How to quantify/model climate change impacts

- Methodology: Integrated Assessment Modeling

1. Production, Consumption, Demographics, Technology
2. GHG Emissions, SO2 emission
3. GHG concentrations, Radiative forcing, sulphate cooling
4. Climate & Temperature Change
5. Damage functions
6. Adaptation
7. Impacts (Loss of GDP)
How to quantify/model climate change impacts

- Modeling climate change impacts: the case of Southeast Asia
  - Total damage could be equivalent to losing 6.7% of GDP each year by 2100
  - More than twice the global average
Social Cost of Carbon

- What is Social Cost of Carbon (SCC)?
  - Social cost of carbon is the net present value of the total (global) economic costs of climate change caused by a small increase in carbon emissions (e.g., a ton) – a measure of global externality
  - Estimate of social costs of carbon is very sensitive and is driven by a number of uncertain factors
Social Cost of Carbon

- Key Driving Factors of SCC
  - Model structure
  - Discount rate and time horizon
  - Impact coverage
    - Agriculture, water, coastal, health, ecosystems, extreme events, energy (but many missing and unknown)
  - Scenarios
    - Emissions, growth, demographic, mitigation, adaptation
  - Direct vs indirect impacts
    - sector-specific aggregate (direct) v.s economy-wide (direct+indirect)
  - Equity weighting
  - Uncertainty and irreversibility
### Social Cost of Carbon

- Current mean estimates of social cost of carbon (1995 $/tC)

<table>
<thead>
<tr>
<th></th>
<th>All studies</th>
<th>Sub-samples based on pure rate of time preference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Mean</td>
<td>105</td>
<td>232</td>
</tr>
<tr>
<td>StDev</td>
<td>243</td>
<td>434</td>
</tr>
<tr>
<td>Observations</td>
<td>232</td>
<td>38</td>
</tr>
</tbody>
</table>

*Source: Tol (2009)*
Social Cost of Carbon

- The choice of discount rate matters

Value of $100 over time using different discount rates
Considering climate change in project economic analysis

- Adaptation
  - Adaptation refers to actions in response to actual or expected climate change impacts to reduce damages
  - Conventional framework applies: both costs and benefits are domestic/local
  - Economic benefits take the form of avoided damages from climate change, which is sometime difficult to estimate
Mitigation

- Refers to actions that reduce GHG emissions relative to a base-line.

Mitigation - CDM projects (Case 1)

- Revenues from selling certified emission reduction credits (CER) should be considered as project economic benefits
- CER prices reflect WTP of households in Annex-I countries
Considering climate change in project economic analysis

- Trends of CER Prices

Source: Point Carbon
Considering climate change in project economic analysis

- Mitigation - Non-CDM projects (with legally binding targets, Case 2)
  - Benefits from mitigation to be measured by the shadow price of carbon (based on domestic trading price of emission permit, or carbon tax, or domestic marginal abatement cost)

- Mitigation - Non-CDM projects (without legally binding targets, Case 3)
  - Only a proportion of SCC can be considered as benefits from mitigation, which could practically be zero.
  - But any international assistance for mitigation should be considered as benefits.
  - Even without international assistance, global benefits from mitigation should be documented.
Considering climate change in project economic analysis

- Mitigation – Emission reduction accounting
  - Need to specify the base-line scenario.
  - In the case of non-incremental output, the base-line scenario is the option to be replaced.
  - In the case of incremental output, the base-line is the option a country would adopt without ADB assistance.
Considering climate change in project economic analysis

Current Practices in MDBs

- **ADB**
  - CER prices in EIRR calculation of most potential CDM projects
  - IED’s on-going CO2 assessment of transport projects
  - ERD’s on-going research on SCC

- **WB**
  - CER price monitoring for CDM projects
  - Developing GHG accounting tools for energy, forest, and transport

- **IFC**
  - Pilot on shadow pricing of carbon in project economics underway
  - From Feb 2009, all real sector projects require GHG estimation before approval

- **IDB**
  - Testing GHG tool based on selected projects covering energy, transport, agriculture, water, and urban sectors
  - Has been silence on carbon pricing so far
Summary and issues for discussion

- A lot of work has been done on GHG accounting, but very little on pricing (what price and how to incorporate it in project economic analysis).
- Methodology depends on the context of each DMC and the nature of each project (see 3 cases).
- Need to develop practical approach and provide guidelines for implementation.
- Look at and learn across MDBs to develop consistent approaches.
- More straightforward for adaptation/climate-proofing projects -- need for guidelines.
Thank you