Climate Change Burden Sharing: A Reappraisal of the Equity Debate

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Outline

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Motivation

• Despite Kyoto Protocol and other agreements there is still stand-off in Climate Change Burden Sharing (BS)
  – Multiple principles – ‘common but differentiated responsibilities’; ‘polluter pays’
  – Continuing Climate-Equity Debate – esp. North vs South
  – Mitigation BS continues to be an issue:
    Overall annual cost of reaching $2^0$ C: 1-3.5% of world GDP (Stern, 2006)
  – Lack of clarity on Post-Kyoto (2012) regime
  – Adaptation burden sharing is over-and-above the mitigation burden sharing
Motivation

• While several reasons exist for lack of consensus on mitigation burden sharing (e.g., high costs associated; uneven distribution of CC impacts and vulnerabilities), this paper tries to explore the possibility of
  – Incorporating CC impact in mitigation BS to facilitate consensus, and
  – Identifying welfare foundations that would corroborate the proposed BS framework
Literature

• Past studies on BS have used either single or multi-criteria: population, historical emission, current emission, GDP
  – Brazilian Proposal (1997)
  – Gupta and Bhandari (1999) – Equal per-capita emission: $CE_{it} = APE_t \times POP_{it}$
  – Sagar (2000) – ‘rights to the atmosphere’ and UNFCCC principle
  – Parikh and Parikh (2009) – rent seeking (Pop.)
  – Mattoo and Subramanian (2010) – future development opportunities (favours countries with high development priorities) and adjustment costs (cushions those who have to make drastic emission cuts from now)
Objective

• Explore design of a mitigation BS framework based on the UNFCCC principle of “Common but Differentiated Responsibility” and conventional wisdom principle of “Victim Compensation” using a criteria that has not been followed in the literature so far – namely, climate change impact costs; and draw parallels with “Welfare Economics” literature to get an insight on climate-equity debate
Methodology and Data

• Share of emission entitlements for \(i^{th}\) country:

\[
F_i = \frac{\sum_{i=1}^{n} \left( \frac{Pop_i \times f(pcGDP_{pppi}) \times h(M_i)}{f(pcCR_i)} \right)}{\sum_{i=1}^{n} \left( \frac{Pop_i \times f(pcGDP_{pppi}) \times h(M_i)}{f(pcCR_i)} \right)}
\]

• Population, PPP adj. GDP, Curr. Emi. – 2004 data; 69 countries
  Source: HDR-2007/08; WEOD, IMF, 2006/07; WRI, 2007

• Historical Emissions – 1950-2004 (CDIAC, Oak Ridge National Laboratory, U.S.A.)

• CC Impact (Cline, 2007)
  – Sector: Agriculture
  – Time: 2080s (2070-2099)
  – Across 69 countries
  – Uses crop simulation and Ricardian approach
  – Impact costs: Loss in agricultural yield reported in 2004 adj. US $
Methodology Contd…

<table>
<thead>
<tr>
<th>Framework</th>
<th>Scheme</th>
<th>Allocational Basis</th>
<th>Underlying Equity Principles</th>
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<tbody>
<tr>
<td>Burden Sharing Framework Without Impact (BSWOI)</td>
<td>1)</td>
<td>$\frac{Pop_i \cdot pcGDP_i}{pcCR_i}$</td>
<td>Egalitarian, Ability-to-pay, Polluter pays</td>
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<td>2)</td>
<td>$\frac{Pop_i \cdot \log(pcGDP_i)}{\log(pcCR_i)}$</td>
<td>Egalitarian, Ability-to-pay, Polluter pays</td>
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<td>3)</td>
<td>$\frac{Pop_i \cdot pcGDP_i \cdot \left(1 + \frac{M_i}{agGDP_i}\right)}{pcCR_i}$</td>
<td>Egalitarian, Ability-to-pay, Polluter pays, Victim compensation (based on impact per-unit of agricultural GDP)</td>
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<td>4)</td>
<td>$\frac{Pop_i \cdot \log(pcGDP_i) \cdot \left(1 + \frac{M_i}{agGDP_i}\right)}{\log(pcCR_i)}$</td>
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<td>6)</td>
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</tr>
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Note: In Schemes 1, 3, and 5, the denominator was set at 1 for the countries where $pcCR < 1$. In Scheme 2, 4 and 6 for which $\log (pcCR)$ becomes infinitesimally small when $pcCR$ approaches 1, the denominator was $\log (pcCR)$ for $CR > 10; (1 + \log (pcCR))/2$ for $10 > pcCR > 1; 0.5$ for $pcCR < 1$. Source: Updated from Sagar (2000).
Aggregation of Countries

PER CAPITA INCOME
PER CAP. HIST. EMISSION
POPULATION
CC IMPACT
COUNTRY GROUPS

Rich Group

High Inc. → High Emi → High Pop → High Imp → HHHH
High Inc. → High Emi → Low Pop → Low Imp → HHHL
High Inc. → Low Emi → High Pop → High Imp → HHLH
High Inc. → Low Emi → Low Pop → Low Imp → HHLL

Poor Group

Low Inc. → High Emi → High Pop → High Imp → HLHH
Low Inc. → High Emi → Low Pop → Low Imp → HLHL
Low Inc. → Low Emi → High Pop → High Imp → HLLH
Low Inc. → Low Emi → Low Pop → Low Imp → HLLL

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Aggregation Scheme

• HHLL ⇒ High pc Income-High pc Cuml. Emi.-Low Population-Low CC impact
• LLHH ⇒ Low pc Income-Low pc Cuml. Emi.-High Pop.-Low CC impact
• 69 Countries = 12 country-groups
  (6-Rich + 6-Poor)
Single Criteria Results
Mitigation Shares with & without CC Impacts

Scheme 2 = \( \frac{Pop_i \times \log(pcGDP_i)}{\log(pcCR_i)} \)

Scheme 6 = \( \frac{Pop_i \times \log(pcGDP_i)}{\log(pcCR_i)} \times \left(1 + \frac{M_i}{Pop_i}\right) \)
Mitigation Shares with & without CC Impacts

Scheme 2: \[ \text{Scheme 2} = \frac{\text{Pop}_i \cdot \log(\text{pcGDP}_i)}{\log(\text{pcCR}_i)} \]

Scheme 4: \[ \text{Scheme 4} = \frac{\text{Pop}_i \cdot \log(\text{pcGDP}_i)}{\log(\text{pcCR}_i)} \cdot \left(1 + \frac{M_i}{\text{agGDP}_i}\right) \]
Mitigation Shares under Different Impact Schemes

Scheme 4 = \( \frac{\text{Pop}_i \times \log(pGDP)}{\log(pcCR)} \times \left(1 + \frac{M_i}{agGDP_i}\right) \)

Scheme 6 = \( \frac{\text{Pop}_i \times \log(pGDP)}{\log(pcCR)} \times \left(1 + \frac{M_i}{\text{Pop}_i}\right) \)
Results - summary

• Highlights:
  – Developing (Poor) Countries largely benefit due to addition of CC impacts in the allocation framework
    • Highly vulnerable (and populous) countries benefit within rich as well as poor country groups
  – Impact specification matters: marginal changes in allocation under Sch. 4 (impact per-GDP) but significant changes in allocation under Sch. 6 (impact per-capita)
  – Allocation with CC impacts resemble the per-capita based entitlements

• Argument:
  – CC impact ~ public bad
  – Provides justification for giving higher entitlements to vulnerable entities
  – Higher entitlements ⇒ facilitate higher growth ⇒ higher output ⇒ better ability to take CC shocks (impacts) into stride
Discussions

• ↑Emission ~ ↑ growth opp. ~ ↑ welfare
• Point of interest: compare emission entitlements across country-groups & check if the BS framework outcomes satisfy any principle of distributive justice
• Q: how to distribute emission rights among rich-polluting country with low population and facing low CC impact (HHLL) and a poor, low emitting, populous, high CC impact bearing country (LLHH)?
• Welfare-theoretic justification of emission entitlements using Equity principle ⇒ Equitable outcome
Discussions

• Sen (1973) – Weak Equity Axiom (WEA)
  • e.g., if \( W(\text{LLHH}) < W(\text{LLHL}) \), then
    \[
    E_{\text{LLHH}} > E_{\text{LLHL}}
    \]
    – victim compensation
  • if \( W(\text{LLHH}) < W(\text{HHLL}) \), then
    \[
    E_{\text{LLHH}} > E_{\text{HHLL}}
    \]
    – Ability to pay, polluter pays, egalitarian, victim compensation
Conclusion

• There is increasing pressure for developing country participation in global emission mitigation efforts
  – For variety of reasons such moves are still not acceptable to developing countries and also do not satisfy equity criteria
• Combining Pop, hist. emi., pc income earlier studies argue in favour of equitable outcome (Sagar, 2000) that gives higher emission entitlements to developing countries
  – Those studies have also identified differences between North and the South and also within North and South
• Adding CC impact as a global public bad (externality) facilitates incorporation of relative vulnerabilities of countries in the BS framework
• Emission rights allocation based on ‘victim compensation’ principle helps to provide cushion to the vulnerable entities and satisfies principle of distributive justice
Conclusion

• While the higher emission entitlements would give the developing countries much needed space to grow, it need not imply inaction from developing countries.

• Several ‘Green Economy’ initiatives in emission intensive sectors such as energy could enable the developing countries to address local as well as global pollution problems simultaneously.
  – Such pro-active approach by developing countries would also go long way in bringing consensus in global climate negotiations.

• Extensions - possibility of a dynamic framework.
Thanks for your Attention!