Climate Change Burden Sharing: A Reappraisal of the Equity Debate

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Outline

- Motivation
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- Objective
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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: $CE_{it} = APE_t * POP_{it}$
  - 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:

$$F_i = \frac{Pop_i * f(pcGDP_{PPPi}) * h(M_i) / f(pcCR_i)}{\sum_{i=1}^{n}[Pop_i * f(pcGDP_{PPPi}) * h(M_i) / f(pcCR_i)]}$$

- 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
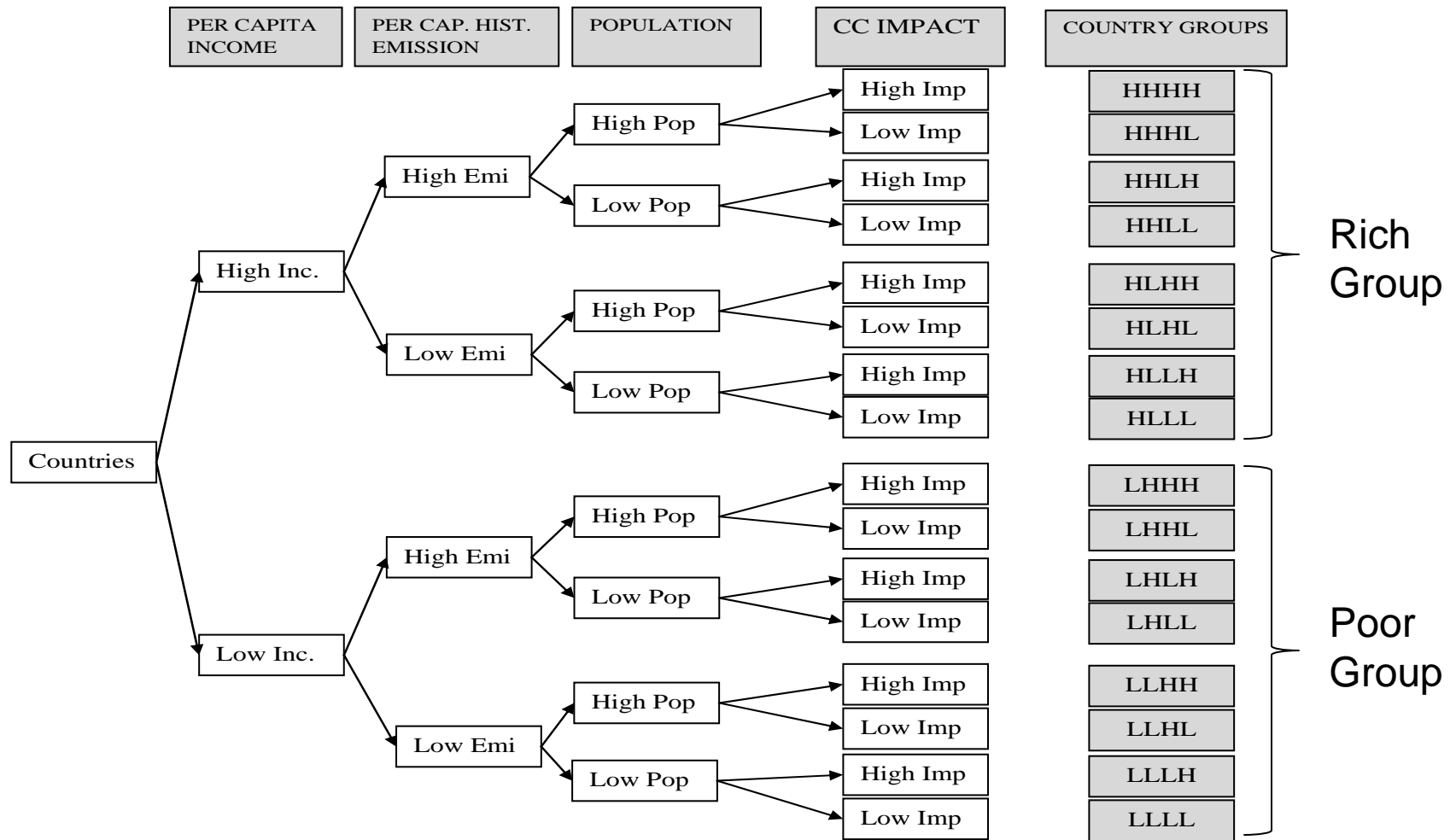 - Impact costs: Loss in agricultural yield reported in 2004 adj. US $

Methodology Contd…

Burden Sharing Schemes and Underlying Equity Principles

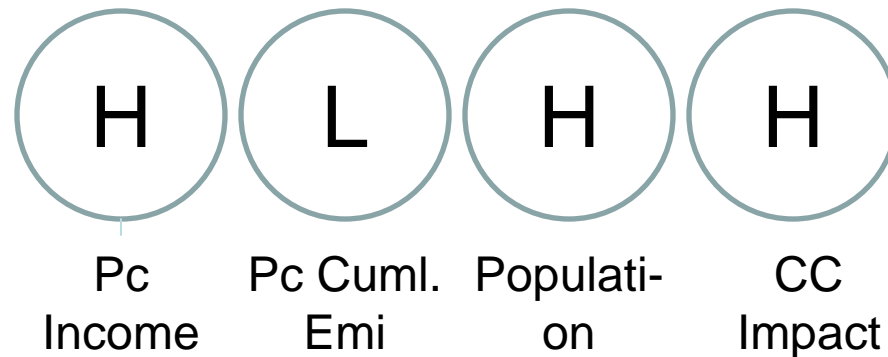| Framework	Scheme	Allocational Basis	Underlying Equity Principles
Burden Sharing Framework Without Impact (BSWOI)	1)	$\dfrac{Pop_i * pcGDP_i}{pcCR_i}$	Egalitarian, Ability-to-pay, Polluter pays
	2)	$\dfrac{Pop_i * \log(pcGDP_i)}{\log(pcCR_i)}$	Egalitarian, Ability-to-pay, Polluter pays
Burden Sharing Framework With Impact (BSWI)	3)	$\dfrac{Pop_i * pcGDP_i}{pcCR_i} * \left(1 + \dfrac{M_i}{agGDP_i}\right)$	Egalitarian, Ability-to-pay, Polluter pays, Victim compensation (based on impact per-unit of agricultural GDP)
	4)	$\dfrac{Pop_i * \log(pcGDP_i)}{\log(pcCR_i)} * \left(1 + \dfrac{M_i}{agGDP_i}\right)$	Egalitarian, Ability-to-pay, Polluter pays, Victim compensation (based on impact per-unit of agricultural GDP)
	5)	$\dfrac{Pop_i * pcGDP_i}{pcCR_i} * \left(1 + \dfrac{M_i}{Pop_i}\right)$	Egalitarian, Ability-to-pay, Polluter pays, Victim compensation (based on impact per-capita)
	6)	$\dfrac{Pop_i * \log(pcGDP_i)}{\log(pcCR_i)} * \left(1 + \dfrac{M_i}{Pop_i}\right)$	Egalitarian, Ability-to-pay, Polluter pays, Victim compensation (based on impact per-capita)

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	
		High Pop	High Imp	HHHH	
			Low Imp	HHHL	
	High Emi	Low Pop	High Imp	HHLH	Rich Group
			Low Imp	HHLL	
High Inc.		High Pop	High Imp	HLHH	
			Low Imp	HLHL	
	Low Emi	Low Pop	High Imp	HLLH	
Countries			Low Imp	HLLL	
		High Pop	High Imp	LHHH	
			Low Imp	LHHL	
	High Emi	Low Pop	High Imp	LHLH	Poor Group
			Low Imp	LHLL	
Low Inc.		High Pop	High Imp	LLHH	
			Low Imp	LLHL	
	Low Emi	Low Pop	High Imp	LLLH	
			Low Imp	LLLL	

Aggregation Scheme

H	L	H	H
Pc Income	Pc Cuml. Emi	Populati-on	CC Impact

- 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
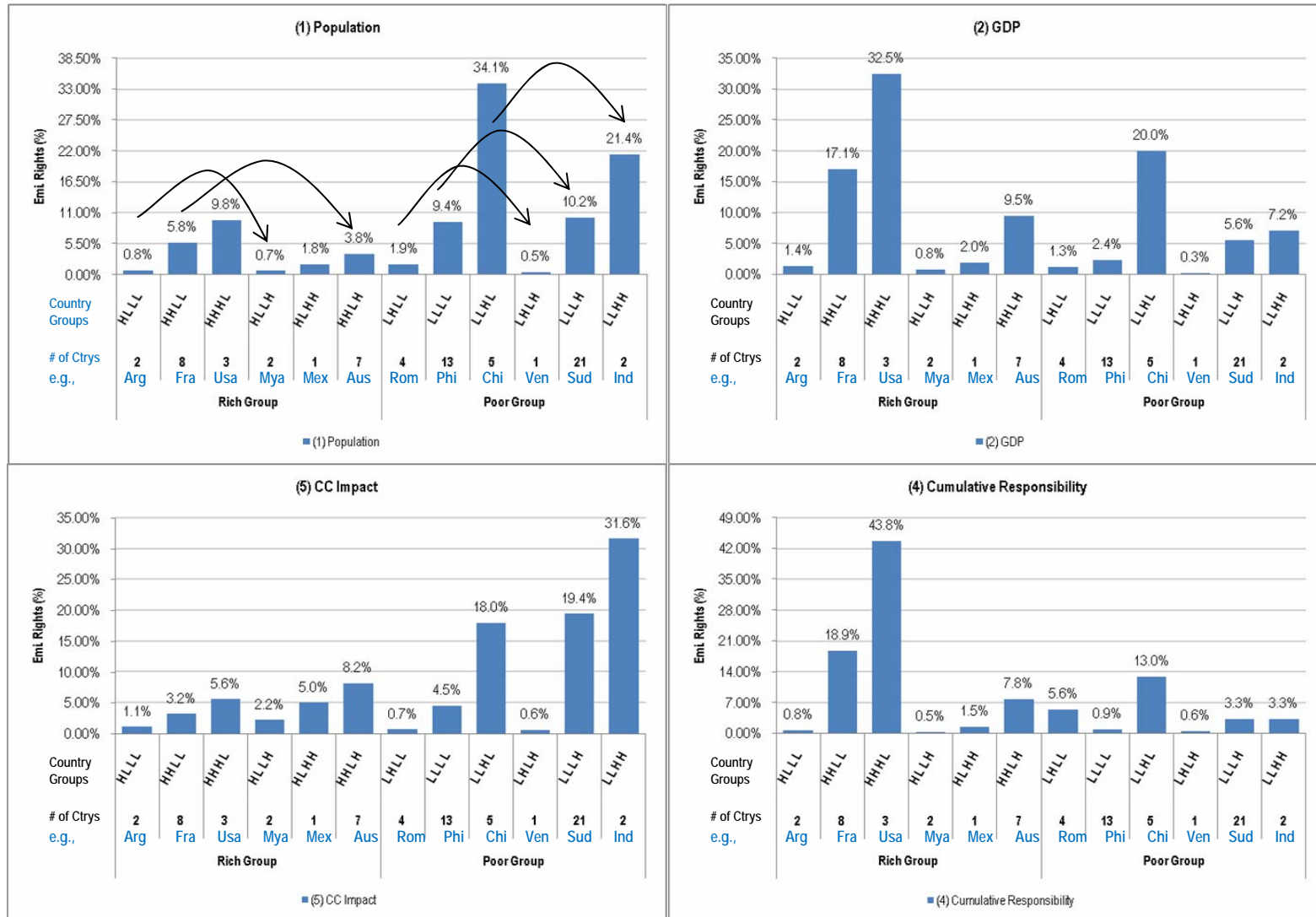
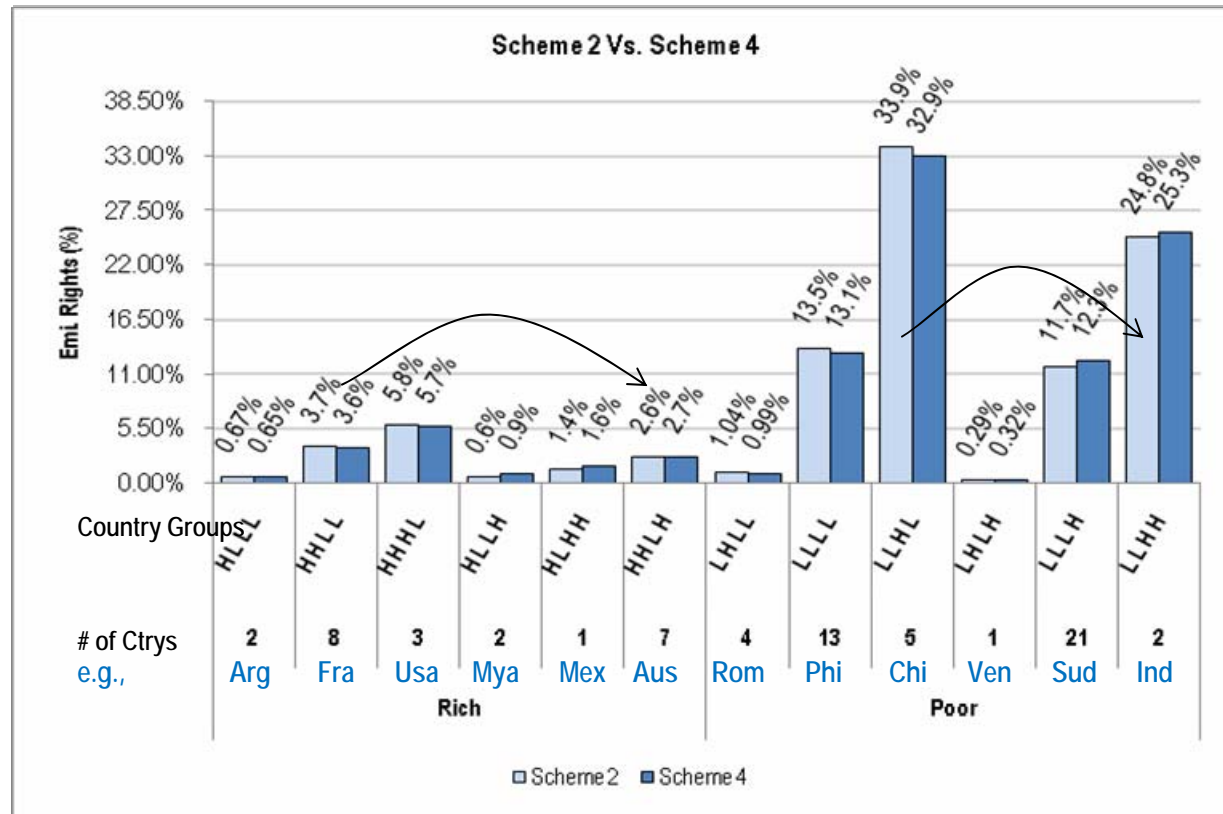# Mitigation Shares with & without CC Impacts
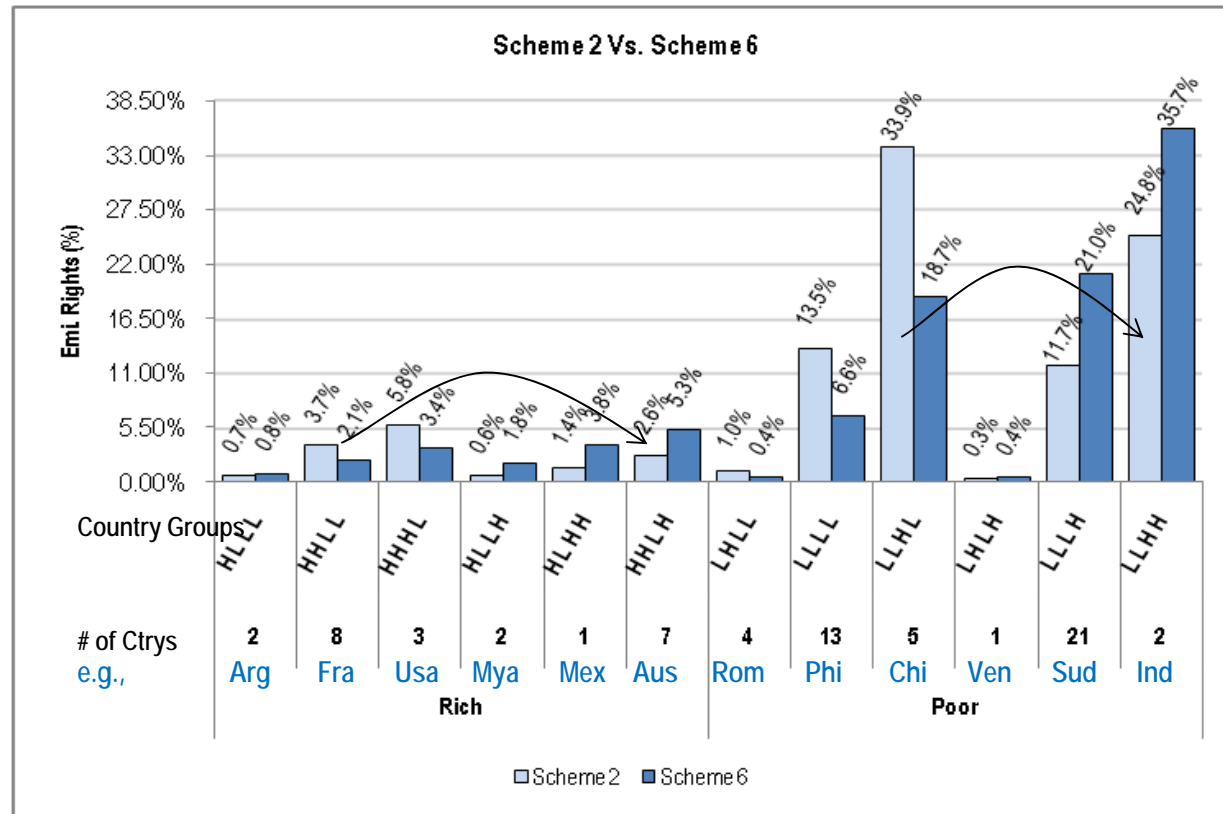
Scheme 2 Vs. Scheme 6

$$\text{Scheme } 2 = \frac{Pop_i * \log(pcGDP_i)}{\log(pcCR_i)}$$

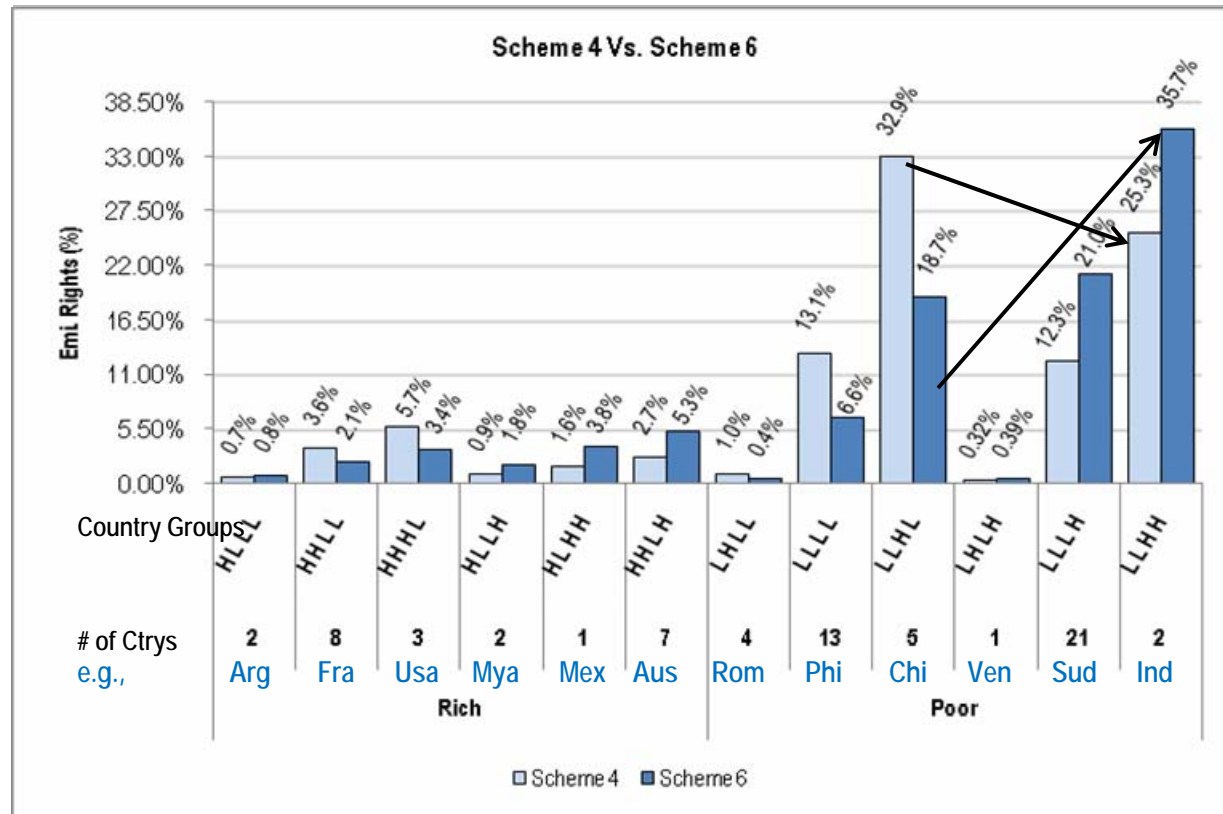$$\text{Scheme } 6 = \frac{Pop_i * \log(pcGDP_i)}{\log(pcCR_i)} * \left(1 + \frac{M_i}{Pop_i}\right)$$

Mitigation Shares with & without CC Impacts

Scheme 2 Vs. Scheme 4

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

$$Scheme\ 4 = \frac{Pop_i * \log(pcGDP_i)}{\log(pcCR_i)} * \left(1 + \frac{M_i}{agGDP_i}\right)$$

Mitigation Shares under Different Impact Schemes

$$\text{Scheme } 4 = \frac{Pop_i * \log(pcGDP_i)}{\log(pcCR_i)} * \left(1 + \frac{M_i}{agGDP_i}\right) \qquad \text{Scheme } 6 = \frac{Pop_i * \log(pcGDP_i)}{\log(pcCR_i)} * \left(1 + \frac{M_i}{Pop_i}\right)$$

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 $\Rightarrow$ facilitate higher growth $\Rightarrow$ higher output $\Rightarrow$ 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 $W(LLHH) < W(LLHL)$, then

$$E_{LLHH} > E_{LLHL}$$

  – victim compensation
- if $W(LLHH) < W(HHLL)$, then

$$E_{LLHH} > E_{HHLL}$$

  – 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 brining consensus in global climate negotiations

- Extensions - possibility of a dynamic framework

Thanks for your Attention!