

Formulas for Quantitative Emission Targets

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**Architectures for Agreement:
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We are sorely in need of ideas as to how to proceed to address the emission of Greenhouse Gases

- The Kyoto Protocol is the only multilateral framework we have to address the problem, but
- the Protocol is inadequate, in 3 important ways:
 - its goals will be costly to achieve if interpreted literally;
 - the largest and fastest-growing emitters have not signed up;
 - in itself, it would make only a tiny dent in GHG concentrations.

A constructive approach

- “You’re Getting Warmer: The Most Feasible Path for Addressing Global Climate Change Does Run Through Kyoto.”
- Features of Kyoto worth building on
 - Politics: Quantitative limits maximize national sovereignty
 - Economics: Market mechanisms, such as intl. permit trading.
- What should be the 2nd step, a successor to the 2008-2012 regime, to build on what is good about Kyoto, & fix what is lacking?

Desiderata for the next stage: requirements for next multilateral treaty

1. *More comprehensive participation*

specifically getting US, China, *et al*, to join

2. *Efficiency* (cost minimization)

3. *Dynamic consistency* (credible century path)

4. *Equity* re poor countries

5. *Compliance*

(Don't expect anyone to accept huge economic costs.)

6. *Robustness under uncertainty*

1. We need to get developing countries into the system for 3 reasons.

- (i) They are the **source of big coming Δ emissions**, according to Business-as-Usual path (BAU)
- (ii) **Leakage:** If Kyoto is implemented without developing countries, their emissions are likely to rise even faster than BAU
- (iii) The **opportunity** for rich countries to **buy relatively low-cost** emissions abatement from poor countries
 - is crucial to keep their economic cost low, and
 - would make them more likely to comply with commitments.

2. Efficiency: minimize economic costs of achieving a given environmental goal.

- ***“Where flexibility”***

- Via international trading of permits =>

- sharp cost reductions estimated from trading

- 80%, if key developing countries are in

- Sources: CEA (1998); Edmonds, et al (1992, 97)

- ***“When flexibility”***

- ***“What flexibility”***

3. Dynamic consistency

- If the designers of a treaty announce a path for steep reductions in the distant future,
 - their successor governments won't follow through when the time comes.
 - Those making investment decisions today realize this inconsistency, & act accordingly.
 - Clinton would have been laughed out of town if he had announced in 1997 that his Climate Change plan was to do nothing until 2050 & then institute tough emission cuts in the 2nd half of the century .

4. *Equity*

- Developing countries have contributed only 20 % of the CO₂ accumulated in the atmosphere over past 150 years.
- They do not have the ability to pay for emissions abatement as rich countries do.
- Their governments have higher priorities.
- India: “equity requires setting targets at equal amounts per capita.” (Unrealistic.)

5. Compliance & 6. Robustness under uncertainty

- **No country will accept huge economic costs**
 - *Ex ante*, they won't agree to such a treaty
 - *Ex post*, they wouldn't abide by it.
- **We want to set targets in future rounds**
 - so that *ex ante*, costs re BAU are small
 - and *ex post*, costs are robust with respect to unknown future developments.

Proposed Architecture for Quantitative Emissions Targets

- Unlike Kyoto, my proposal seeks realistically to bring all countries in, & to look far into the future.
- But we can't pretend to see with as fine a degree of resolution at century-long horizon as at 4-year horizon.
- Consider different horizons in turn.
 - *The century-long horizon*
 - *The decade horizon*

Century-long horizon: building confidence within a LR framework

- Need a sequence of negotiations, fitting within a common flexible framework
 - like the General Agreement on Tariffs & Trade.
- How to set sequence of quantitative targets?
 - a decade at a time.
 - \leq Fixing targets a century ahead is impractical.
 - Key contribution of this chapter: a proposal how the framework would allocate targets *across* countries.

The decade horizon: formulas for setting targets

- A nested sequence of formulas for emissions.
- Formulas would be very general for the distant future, & become increasingly specific as each budget period draws close.
- The BAU baseline entails rapid increases in emissions for such countries as China & India => even with cuts relative to the baseline, we are talking about “growth targets” for such countries, not cuts in the absolute levels of emissions.

Formula for targeted reductions would include among its determinants:

- 1990 emissions
- emissions in the year of the negotiation
- population
- income, and
- perhaps a few other special variables
 - whether the country in question has coal
 - or hydroelectric power.

Proposed properties of formulas in 1st budget period of membership

- As the year approaches in which a country 1st joins, agreed target for next budget window is set by reference to estimated BAU path.
 - => country not asked to take on major economic cost in the year it joins.
 - World environment benefits even within the 1st budget period, by pre-empting leakage.

Proposed properties of formula in 2nd budget period

- More serious cuts targeted.
- Cuts relative to BAU would assign:
 - less weight to emissions in the year of negotiation,
 - more weight to 1990 levels.
 - Why give any weight to 1990 levels in the medium term?
To assure Europeans that US is not being unduly rewarded for having dropped out of Kyoto & “ramping up” its emissions over 1990-2008 to a higher level from which to negotiate future reductions.

Illustration of Emission Targets

	<i>EU</i>	<i>US</i>	<i>China</i>
<i>1st budget period</i>	Kyoto targets: 1990 level - 8%	BAU level	
<i>2nd budget period</i>	1990 level -20%	Between BAU & 1990	BAU
<i>3rd budget period</i>		1990 level	Below BAU

Persuading developing countries to join a system of quantitative targets

- In the very Long Run, developing countries would notionally achieve their equity-based demand for equal emissions per capita.
 - Even in the short run, quantitative emissions commitments for developing countries, if set carefully, can address everyone's concerns.
- 3 key principles should guide formulation of such targets:
- Mutual gains from trade
 - Progressivity in allocation, &
 - Protection against inadvertent stringency.

The Gains from Trade

- Assume poor countries in their 1st budget period just commit to BAU paths.
- This system can't hurt developing countries:
 - They would have the right to emit whatever would have emitted anyway; they need not undertake cuts unless foreigners pay to persuade them voluntarily.
 - Foreigners would indeed offer to pay enough to persuade poor countries voluntarily to reduce emissions below BAU.
≤ Reductions cost far less there than in US, EU & Japan:
- Both sides win economically from trade.
- The environment benefits too ≤ no leakage.

If developing countries accept targets and trade, everyone wins

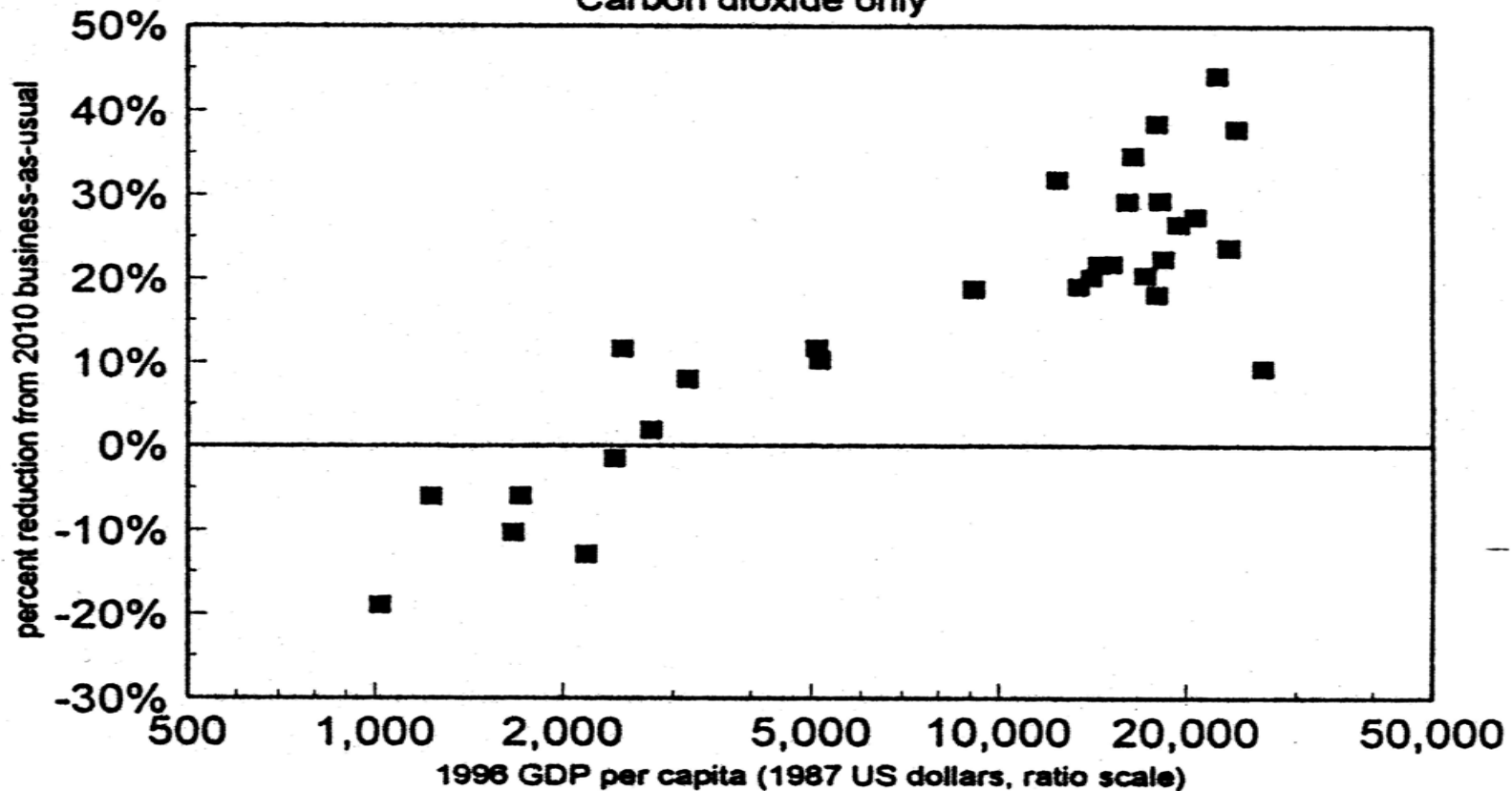
<i>Gains if poor countries join & trade</i>	<i>Economic gains</i>	<i>Environmental gains</i>
Gains for developing countries	Price received for emission cuts > cost	Auxiliary benefits: less air pollution
Gains for industrialized countries	Price paid for emission permits < cost to cut only at home	Precludes leakage of emissions to non-members

Progressive Emissions Commitments

- There is a range of possible targets within which both sides gain. How to set a fair target within it?
- Follow pattern of allocations at Kyoto:
 - CEA estimated that each 1 % in income implied a target of 0.11-0.17 % greater emissions cuts from BAU (see Fig. 1).
 - Extrapolate this pattern to new members.

The targeted reductions from BAU agreed to at Kyoto were progressive with respect to income.

Figure 1. Emissions reduction vs. GDP per capita
Carbon dioxide only



Sources: The World Bank, U.S. Energy Information Administration, national communications to the UNFCCC

Resolving Concerns about Unintended Target Stringency

- How to minimize risk of either inadvertent stringency or laxity (“hot air”)?
- ***Index to income.***
 - E.g., from 2008: for every 1% growth above expectations, raise target 0.7%.
 - Goal: maximize probability that target ends up within range of gains for all
 - robust under uncertainty.



Framework for Emission Targets & Timetables

A sequence of formulas setting country targets as functions of income, pop. & lagged emissions.

<i>Time Table</i>	<i>Europe & Japan</i>	<i>US & Australia</i>	<i>China & other poor countries</i>
<i>2008-2012</i>	Cuts below 1990 levels, agreed at Kyoto (as illustrated in Fig. 1 relative to BAU)	BAU, as estimated at the date of joining	No targets
<i>2013-2020</i>	Further cuts (relative to BAU estimated in the year of negotiation, say 2008). Bigger cuts for richer countries, analogously to pattern in Fig. 1. Targets partially indexed to income within decade (though perhaps numbers to be fixed in 2015, to facilitate trading during 2016-2020).	Targets put less weight on 2008 levels, more on 1990 levels, moving in direction of Europe.	Targets = BAU as estimated at date of joining, say 2008. Partially indexed to income (though perhaps intensities are fixed in 2015)

Framework for Emission Targets & Timetables

continued to end of century

<i>Time Table</i>	<i>Europe & Japan</i>	<i>US & Australia</i>	<i>China & other poor countries</i>
2021-2030	Weights on 1990 emissions vs. 2008 emissions begin to converge (so US not unduly rewarded for staying out). Bigger cuts for richer countries, analogously to pattern in Fig. 1. Targets are again partially indexed to income within the decade.		1st cuts, relative to BAU, steeper for those attaining higher income, as in Fig.1.
2031-2040	Weight on population starts to rise, relative to weights on lagged emissions & income. Partial indexation within the decade.		
2041-2050	Weight on population continues to increase, weights on lagged emissions and income continue to diminish, with 1990 emissions weight vanishing. Partial indexation within the decade.		
...			
2091-2100	No weight on lagged emissions. Countries with higher income still get higher targets, but much less so than early in century.		
$t \rightarrow \infty$	Equal emissions per capita		