

Can Negotiating a Uniform Carbon Price Help to Internalize the Global Warming Externality?

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European Seminar

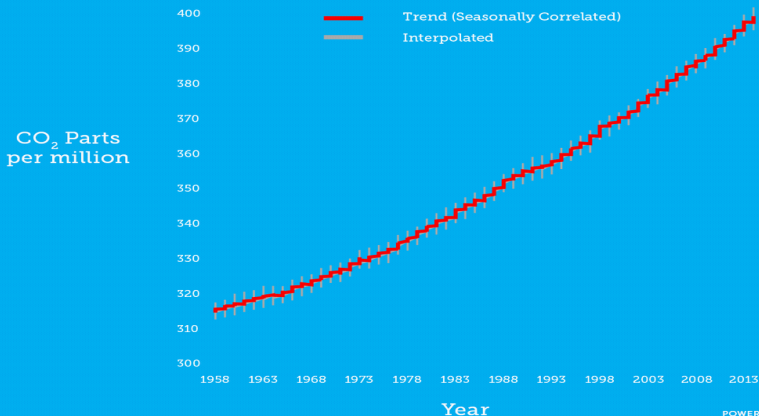
The climate system is an angry beast and we are poking it with sticks.
—Wallace Broecker

Climate change is the biggest market failure the world has ever seen.
—Nicholas Stern

October, 2015

The Keeling Curve

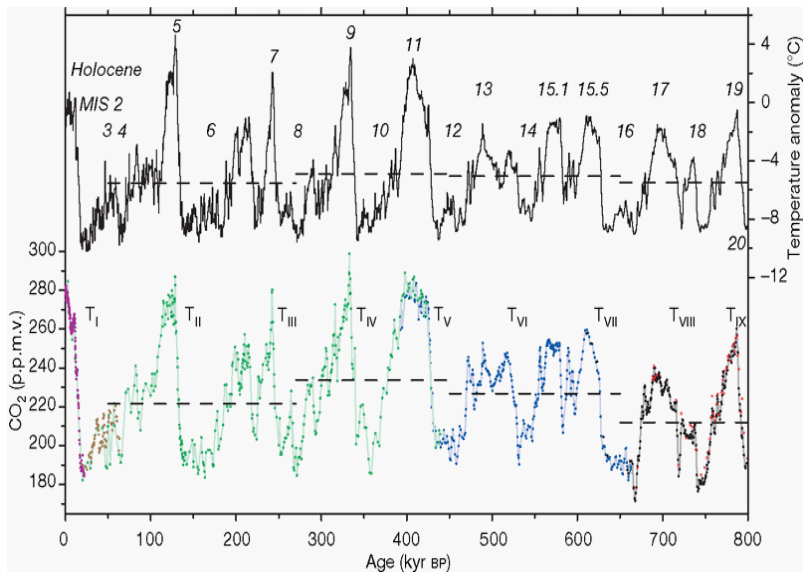
Rising Carbon Dioxide Levels



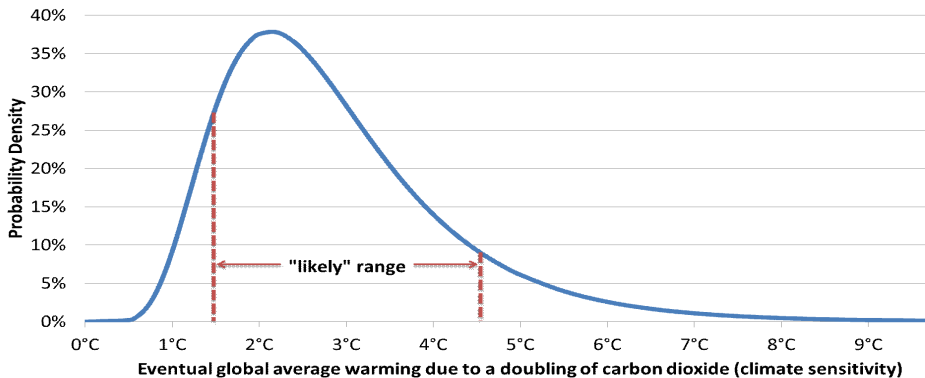
Source: ftp://ftp.cmdl.noaa.gov/products/trends/co2/co2_mm_mlo.txt

POWERED BY VISAGE

800-K-Year Antarctic Ice Record of CO₂ and Temps



Probability Distribution of Climate Sensitivity



Where Am I Coming From?

- Go over Keeling Curve, Antarctic Ice Core Record, Climate Sensitivity.
- Based on IPCC AR5 description of climate sensitivity probabilities:

ppm CO ₂ e	450	500	550	600	650	700	750	800
Median ΔT	1.8°	2.2°	2.5°	2.7°	3.2°	3.4°	3.7°	3.9°
Pr[$\Delta T \geq 6^\circ C$]	.3%	1.2%	3%	5%	8%	11%	14%	17%

- Caveats? Implications? Damages? Timing? Discounting?
- Irreversibility: $\approx 70\%$ of atmospheric (CO₂-280) remains after 100 years; $\approx 40\%$ of atmospheric (CO₂-280) remains after 1000 years.
- Climate change has deep structural uncertainties and an inability to exclude catastrophes. Potentially unlimited downside liability.
- Climate change as “mother of all externalities.” Carbon-free solution seems expensive. GHG mitigation is a huge international public good without international governance. *Very serious free riding problem.*
- In light of this enormous public-goods free-rider problem, are prices or quantities better choice for basic control/negotiation instrument?

Negotiating Prices vs. Negotiating Quantities

- History/spirit of Kyoto and beyond (my interpretation). Essentially quantity based. Breakdown of top-down approach. Current emphasis on bottoms-up approaches.
- Where does the global warming public goods problem now stand? Global warming gridlock. Pledge and review? More restraint than narrow free riding but much less restraint than social optimum.
- I revisit top-down solutions in prices and quantities using fiction of a majority-rule voting system. *Very futuristic*. Opportunities for comprehensive solutions will arise and we should be ready for them.
- Classical arguments in favor of carbon taxes over tradeable permits – and classical arguments vice versa.
- I add some new arguments in favor of negotiating a uniform minimum carbon price – internationally harmonized but nationally retained.
Some of these arguments are behavioral, non-rigorous, subjective, legitimately criticizable, and inherently involve making judgments.
But problem is important and wants new thinking

Three Desirable Properties for Negotiation Instruments

- 1. *Induce cost effectiveness.*
- 2. Be of *one dimension centered on a “natural” focal point* to facilitate finding an agreement with relatively low transactions costs.
- 3. **Embody “countervailing force” against narrow self interest and against free riding by automatically incentivizing all negotiating parties to internalize the externality.** (Maybe most important property?)
- Using above three criteria, compare and contrast idealized binding harmonized price with idealized binding cap-and-trade system.
- Important point: 'price' here operates like 'tax' whose revenues are domestically retained and internally redistributed.
- *First Pass*: negotiating one price vs. negotiating n quantity caps. Focal points and transactions costs. Externality internalization via one price vs. free riding incentives via n quantity caps.
- Critical distinction between *intra-national assignment* of n caps and *inter-national negotiation* of n caps, which breaks symmetry of PvQ.

The Model and its Social Optimum

- Suppose n countries, indexed $j = 1, 2, \dots, n$. For convenience, fundamental unit is person, everything normalized per capita. World population is m people, indexed $i = 1, 2, \dots, m$. Nation acts on behalf of its (identical) citizens and recycles carbon-price revenues efficiently.
- X_i is abatement of i , with cost $C_i(X_i)$. Universal price of emissions is p . Then

$$C'_i(X_i(p)) = p. \quad (1)$$

World total abatement:

$$X(p) = \sum_{i=1}^m X_i(p). \quad (2)$$

- Benefit to i of X is $B_i(X)$. Public goods optimality condition:

$$p^* = \sum_{i=1}^m B'_i(X(p^*)), \quad (3)$$

where p^* satisfies (1) for all i .

What Price Would i Most Prefer?

- Emissions-price p_i that i would most prefer solves

$$\max_p \{B_i(X(p)) - C_i(X_i(p))\}, \quad (4)$$

which satisfies first-order condition

$$B'_i(X(p_i)) X'(p_i) = C'_i(X_i(p_i)) X'_i(p_i). \quad (5)$$

- Use condition (1) to rewrite (5) as

$$p_i = C'_i(X_i(p_i)) = \lambda_i B'_i(X(p_i)), \quad (6)$$

where

$$\lambda_i \equiv \frac{X'(p_i)}{X'_i(p_i)} = \frac{dX}{dX_i} \quad (7)$$

might be called the *externality-internalizing multiplier* (for agent i).

- Now analyze (6), (7). What story is it telling about golden-rule-like scaling up imputation via λ_i ?

Further Super-Simplifying Assumptions and Results

$$C'_i(X_i) = c_i + \gamma X_i, \quad (8)$$

$$B'_i(X) = b_i. \quad (9)$$

- Give some “justification” for super-simplifying assumptions (8), (9).
- Derive

$$p^* = m \bar{b} \quad (10)$$

$$p_i = m b_i \quad (11)$$

where $\bar{b} = \sum b_i / m$.

- Now compare (10) with (11). Give a pairwise-majority voting interpretation of (11). Median voter result. Then get social optimum price if *median* b_i equals *mean* b_i . Does this give a sense in which negotiating a uniform price tends to get a “good” outcome? (**Note:** I can **not** get analogous satisfying result for voting on quantities.)

Consider Modified Cap and Trade (Second Pass)

- Let total world emissions be Y . Imagine country j is assigned emissions permits Y^j by *reduced-form* linear apportionment

$$Y^j(Y) = \theta^j Y + \alpha^j, \quad (12)$$

where $\theta^j > 0$ and α^j are some fixed *given* distributional coefficients with balancing properties $\sum_{j=1}^n \theta^j = 1$; $\sum_{j=1}^n \alpha^j = 0$.

- Interpretation of (12): assigned reduction from assigned baseline level.
- If Y is negotiated *given* $\{\theta^j, \alpha^j\}$, then similar *qualitative* properties as negotiated p (focal point Y and internalizing externality).
- But then where do Stage-1 $\{\theta^j, \alpha^j\}$ come from? Quantity negotiations again! Again critical distinction between *intra-national assignment* of n caps and *inter-national negotiation* of n caps.
- Quantities require *two* stages of agreement, price only requires *one*.
- What about “naturally symmetric” quantity assignments? Would these make Stage-1 distributional coefficients easier to accept?

Some Questions and Comments (Incomplete)

- **Would serious side payments be required for acceptance of a uniform price? Does this spoil argument? Is my comparison between one negotiated price vs. multiple negotiated quantities really legitimate? Does one price really make distributional issues less explicitly central? Would not “green fund” payments be required for participation in both systems, thereby leading to symmetric multi-dimensional negotiation difficulties?*
- Emphasize *minimum* price on carbon, however attained (cap and trade or tax). Country could go beyond.
- I am thinking that a uniform price is a more “natural” focal point requiring less “greenfund transfers” than any quantity sub-division assignment such as (12), even with “naturally symmetric” quantity assignments. Is the median voter story in favor of price relevant?
- My tentative conclusion: It is difficult to get nations to agree to *anything* on climate change, but negotiating one price is *relatively* easier than negotiating n quantities.

“Climate Club” Extended to a “Climate Assembly” [?]

- William Nordhaus introduced the basic idea of a “climate club” to overcome free riding.
- I want to extend his idea to accommodate a “climate assembly.”
- Members agree to impose the same price of carbon on themselves. They vote on their preferred uniform club-carbon price via one-person one-vote as in this paper and agree to abide by majority rule.
- Members of the climate club agree to free trade among themselves but each one also agrees to charge an ad valorem border tariff of 5% on any non-member country.
- Membership is voluntary, but members must agree to abide by above conditions.
- Nordhaus shows promising outcomes. “Climate Assembly” extension gives a (voting) rule for flexible adjustments of the uniform price as changing conditions warrant.
- To me, this seems like a constructive and promising set of ideas.