

# On a World Climate Assembly and the Social Cost of Carbon

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Seminar

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I argue that a uniform global tax-like price on carbon emissions, whose revenues each country retains, can provide a focal point for a reciprocal common climate commitment, whereas quantity targets, which do not nearly so readily present such a single focal point, tend to rely ultimately on individual quantity commitments.

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## Where Does Public Goods Problem Stand After COP21?

- COP21 Paris is a genuine positive achievement! However ...
- It is completely voluntary with no penalties – either for low ambition targets or for under-fulfillment of voluntary targets – other than “blame and shame.” Based on bottom-up quantity-based INDCs = (1) **[Intended]**; (2) **Nationally-Determined**; (3) **Contributions**.
- I revisit solution in prices vs. quantities, using fiction of a “World Climate Assembly” (WCA) voting on emissions via majority rule, as allegory for thinking about outcomes of climate negotiations.
- Methodology is mix of classical-math-econ with verbal-behavioral-subjective “preponderance of evidence.”
- My approach here is **\*futuristic\***. If/when there is widespread grassroots perception of impending climate-change catastrophes, nations may/will be ready to forego sovereignty and volunteerism in favor of a binding international agreement with “teeth” that “bite.”
- Opportunities for meaningful solutions will likely arise and we should be ready beforehand by thinking through consequences now.

## Three Desirable Properties for Negotiation Instruments

“Classical” P vs Q. Importance of price stability. Revisit P vs Q.  
Arguments as mix of “art” and “science.” Desirable properties include:

- 1. *Induce cost effectiveness.*
- 2. Be of *low – preferably one – dimension based on a “natural” focal point* to facilitate finding an agreement with *relatively low transaction costs*. [“In spirit of”: (1) Hume (desirability of low numbers); (2) Schelling (natural focal point); (3) Coase (low transaction costs); (4) Black (median voter theorem); (5) Arrow (impossibility theorem).]
- 3. *Embody “countervailing force” against self-interested free riding* by automatically incentivizing parties to *internalize the externality* via a simple, transparent, familiar instrument and formula that embodies a *common climate commitment* based on principles of *reciprocity, quid-pro-quo* and *I-will-if-you-will*. (Most important property?)
- Using above three criteria, compare and contrast idealized binding harmonized price with idealized binding cap-and-trade system.

# Negotiating One Price vs. Negotiating Multiple Quantities

Note: 'price' here operates like 'tax' whose revenues are domestically retained and internally redistributed as if by a lump-sum carbon dividend. Country *keeps* tax revenues. Assume no net revenue impact *per se*. (double dividend='+'; inefficient redistribution ='-')

- *First Pass*: negotiating one universal 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.
- Suppose that, in U.S. clean air amendments (1990), EPA had allowed states or power plants to negotiate between themselves their own voluntary SO<sub>2</sub> target caps, with no penalties for either under-ambitious targets or under-fulfillment of under-ambitious targets. Is this a fair comparison with Paris COP21 agreement?

# The Model

- 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) citizen-agents and recycles carbon-tax revenues efficiently. Dynamics compressed into statics.
- $E_i$  is emissions of  $i$ , with cost  $C_i(E_i)$ , where  $C_i' < 0$ ,  $C_i'' > 0$ , Universal price of emissions is  $P$ . Then  $E_i(P)$  satisfies:

$$-C_i'(E_i(P)) = P. \quad (1)$$

- World total emissions:

$$E(P) = \sum_{i=1}^m E_i(P). \quad (2)$$

- Damages to  $i$  of  $E$  is  $D_i(E)$ , where  $D_i' > 0$ ,  $D_i'' \geq 0$ . Total real loss to  $i$  of imposed price  $P$  is

$$L_i(P) = D_i(E(P)) + C_i(E_i(P)). \quad (3)$$

# The Social Cost of Carbon (SCC)

- Total social loss of imposed price  $P$  is

$$L(P) = \sum_{i=1}^m L_i(P) = \sum_{i=1}^m [D_i(E(P)) + C_i(E_i(P))]. \quad (4)$$

- SCC (more accurately “efficiency price of carbon”) is value  $P^*$  of  $P$  that minimizes social loss expression (4).
- Here everyone is simultaneously producer and consumer of public bad. Analogue of Samuelson public goods Pareto optimality condition here is

$$P^* = \sum_{i=1}^m D'_i(E(P^*)), \quad (5)$$

where (1) holds simultaneously for each  $i$  at  $P = P^*$ .

- What is welfare basis (here, in international & intergenerational climate change context) of efficiency condition  $SCC=P^*$ ?

## What Price Would $i$ Most Prefer?

- Uniform emissions-price  $P_i$  that  $i$  would most prefer minimizes loss function expression  $L_i(P) = D_i(E(P)) + C_i(E_i(P))$ , resulting in first order condition

$$D'_i(E(P_i)) E'(P_i) = -C'_i(E_i(P_i)) E'_i(P_i). \quad (6)$$

- Use condition (1) to rewrite (6) as

$$P_i \left[ = -C'_i(E_i(P_i)) \right] = D'_i(E(P_i)) \times \left( \frac{E'(P_i)}{E'_i(P_i)} \right). \quad (7)$$

- Analyze (7), Not free riding solution. Scaling up by  $E'(P_i)/E'_i(P_i)$ .
- Interpretation: Suppose agent  $i$  makes benevolent-dictator partial-golden-rule-like imputation of what *would be* the corresponding world SCC efficiency-price of carbon *if all other agents* had same cost and damages functions as  $i$ . Call this value  $P_i^*$ . Then have important result  $P_i = P_i^*$ . Explain.

## Further Linearity Assumptions and a Result

$$D_i(E) = \alpha_i + d_i E, \quad (8)$$

$$E_i(P) = \beta_i - s_i P. \quad (9)$$

Interpretation:  $d_i$  = marginal damages of  $i$  and  $s_i$  = price sensitivity of  $E_i$ .  
Note that parameter  $s_i$  does “triple duty” because eq. (9) same as

$$-C'_i(E_i) = (\beta_i - E_i)/s_i, \quad DWL_i(\Delta P) = s_i \times (\Delta P)^2 / 2. \quad (10)$$

- Give some “justification” for simplifying linearity assumptions (8), (9).
- Derive basic result and explain simply:

$$P_i = P^* \times \left[ \left( \frac{d_i}{\bar{d}} \right) \div \left( \frac{s_i}{\bar{s}} \right) \right]. \quad (11)$$

where  $\bar{d} \equiv \sum d_i / m$  and  $\bar{s} \equiv \sum s_i / m$ . Go over some special cases.

- Note: in WCA, agent  $i$  would vote for  $P_i$ . Then median voter result. Important: I can **not** get analogous satisfying result for voting on quantities. (What would it even mean?)



## Implications for WCA Majority Voting Outcome

Notation: Let the *median* value of  $\{Z_i\}$  be denoted  $\tilde{Z}$ .

- From (11) and median voter theorem, WCA majority vote is

$$\tilde{P} = P^* \times \left[ \left( \frac{\tilde{d}}{s} \right) \div \left( \frac{\bar{d}}{\bar{s}} \right) \right]. \quad (12)$$

(Imperfect) heuristic argument why two (imperfect) measures of central tendency on rhs of (12) may divide to  $\approx 1$ , implying  $\tilde{P} \approx P^*$ .

- Special case all  $\{s_i\}$  identical gives

$$\tilde{P} = P^* \times \left( \frac{\tilde{d}}{\bar{d}} \right). \quad (13)$$

- Very rough empirical application by Kotchen gives  $P^* = \$40/\text{tCO}_2$  and  $\tilde{P} = \$51/\text{tCO}_2$ . I think this is within measurement error, allowing rough statement in this framework that  $\tilde{P} \approx P^*$ .
- There is simply no good quantity analogue of  $\tilde{P}$ !!!**

## Some Questions and Comments (Incomplete)

- Would serious side payments be required for acceptance of a uniform price? Does this spoil my basic argument because with transfers you ultimately have the same multi-dimensional negotiation difficulties? I think not, based on the several behavioral-psychological and classical-economic arguments that have been made previously.
- Unlike a nationally-retained revenue-neutral carbon tax, allowances in international cap-and-trade create property rights worth many hundreds of billions of dollars. A uniform price-tax is easier to negotiate (because less is at stake) than negotiating the initial allowances in a cap-and-trade system (because more is at stake).
- Emphasize *minimum* price on carbon, however attained (cap and trade or tax). Country could go beyond. Examples.
- Not airtight, but my tentative conclusion: It is difficult to get nations to agree to *anything* on climate change, but negotiating one universal price is *relatively* easier than negotiating n quantity allotments.

## “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, say, 5% (or 10%) on goods imported from any non-member country.
- Membership is voluntary, but members must agree to abide by above customs-union conditions.
- Nordhaus shows promising outcomes. WCA=“World Climate Assembly” extension gives a (voting) rule for flexible adjustments of the uniform price as changing conditions warrant.
- To me, this package of WCA with climate club seems like a constructive approach and promising set of ideas.