Coercive Trade Agreements for Climate Change

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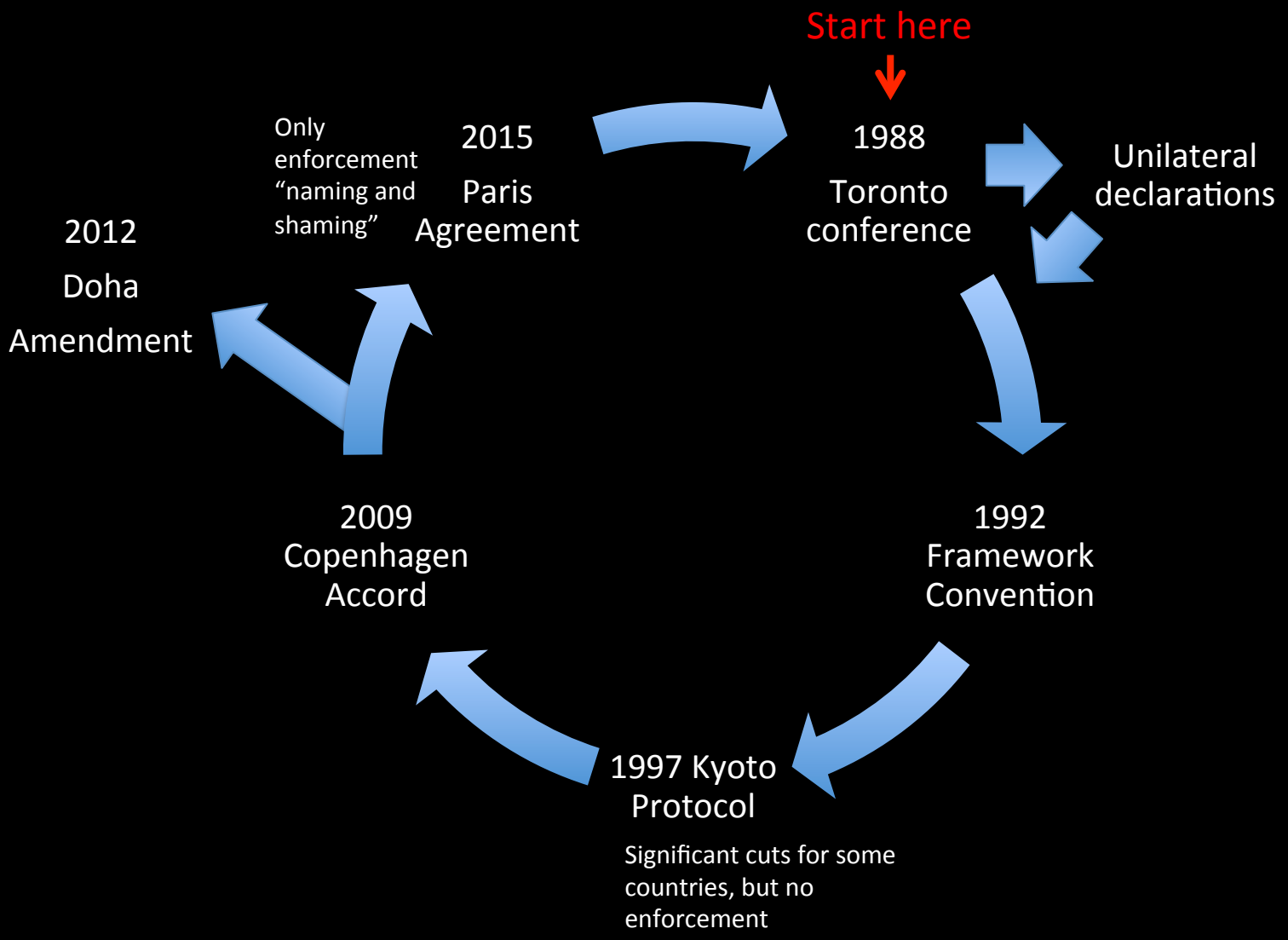
A History of Climate Negotiations



Linking climate to trade

- Since cooperation on trade works, and cooperation on climate change doesn't work, why not make cooperation on trade conditional on cooperation on climate change?
- Trade and climate change are already linked because of "leakage." To correct leakage, countries could adopt border tax adjustments, but this would be difficult and wouldn't address free riding. Why not use a generalized tariff (Lessmann, Marschinski, and Edenhofer 2009; Nordhaus 2015) to deter free riding —and eliminate leakage in the bargain?

Nordhaus's "Climate Clubs" (2015)

- A self-elected group imposes a common carbon tax domestically and a tariff on imports from non-members.
- Tax and tariff determined "outside" the model.
- Not really a club; more like a CLUB!
- Countries heterogeneous. This is a numerical model.
- Solutions determined by an "evolutionary algorithm."
- Threat to punish is credible because of optimal tariff.
- Crucial assumption: no retaliation by non-members.

Nordhaus's results

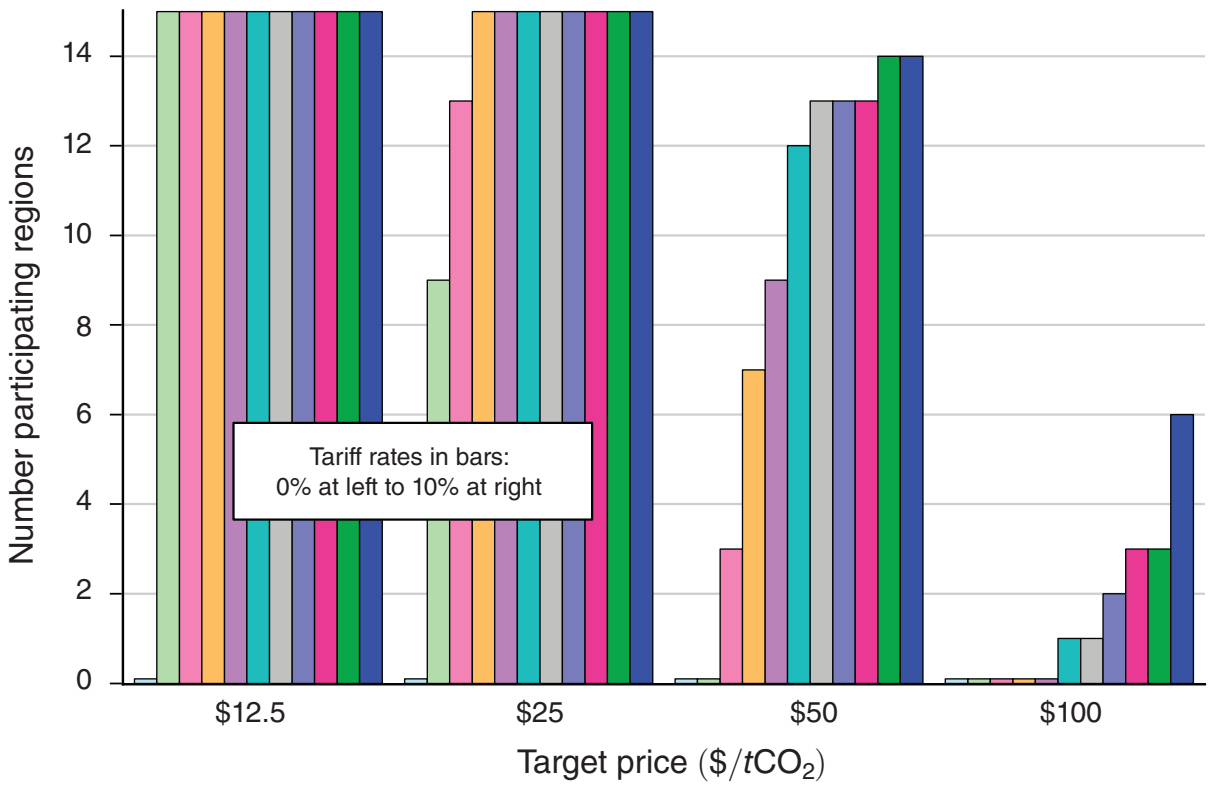


FIGURE 3. NUMBER OF PARTICIPATING REGIONS BY INTERNATIONAL TARGET CARBON PRICE AND TARIFF RATE

Notes: This and the following figures have the following structure. The four sets of bars are the model results for four different global SCCs, running from left to right as shown on the bottom. The 11 bars within each set are the penalty tariff rates, running from 0 percent to 10 percent. Note that each set has zero participants for a 0 percent tariff. The vertical scale here is the number of participants, while the following graphs show other important results.

Our approach

- Start with a trade agreements model.
- Then a climate (voluntary) cooperation model.
- Call the linked agreement a CTA.
- Compare the linked and unlinked games, with and without retaliation.
- Look into the decision to link.
- Our approach is simple and not empirically based, but raises deep questions about behavior and institutional design.

Trade conflict

- *N* symmetric countries, each of which must choose a tariff to impose the others: a prisoners' dilemma:

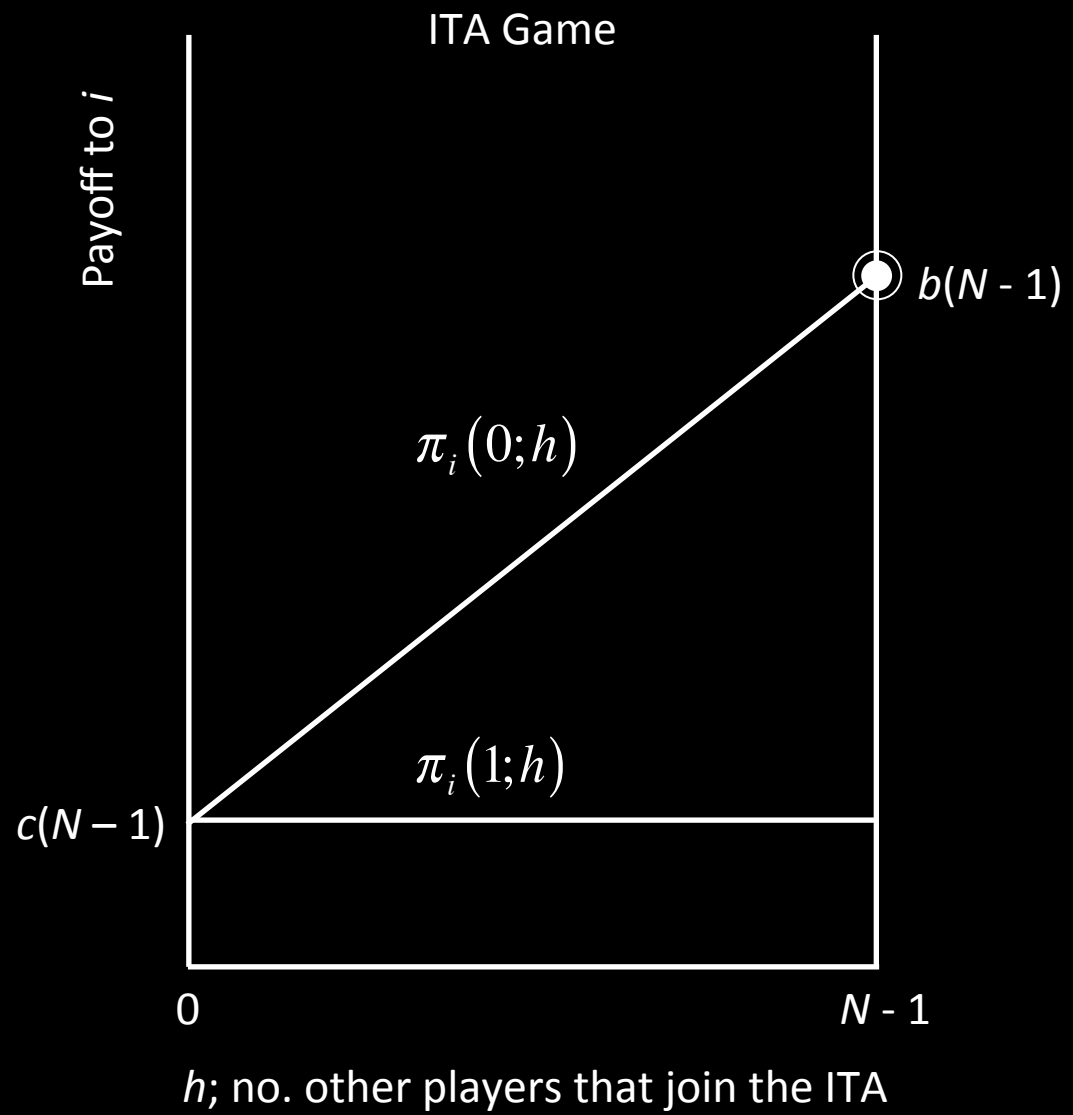
Country *j*

Country *i*	No tariff	Tariff
No tariff	(*b*, *b*)	(*d*, *a*)
Tariff	(*a*, *d*)	(*c* ,*c*)

$a > b > c > d$

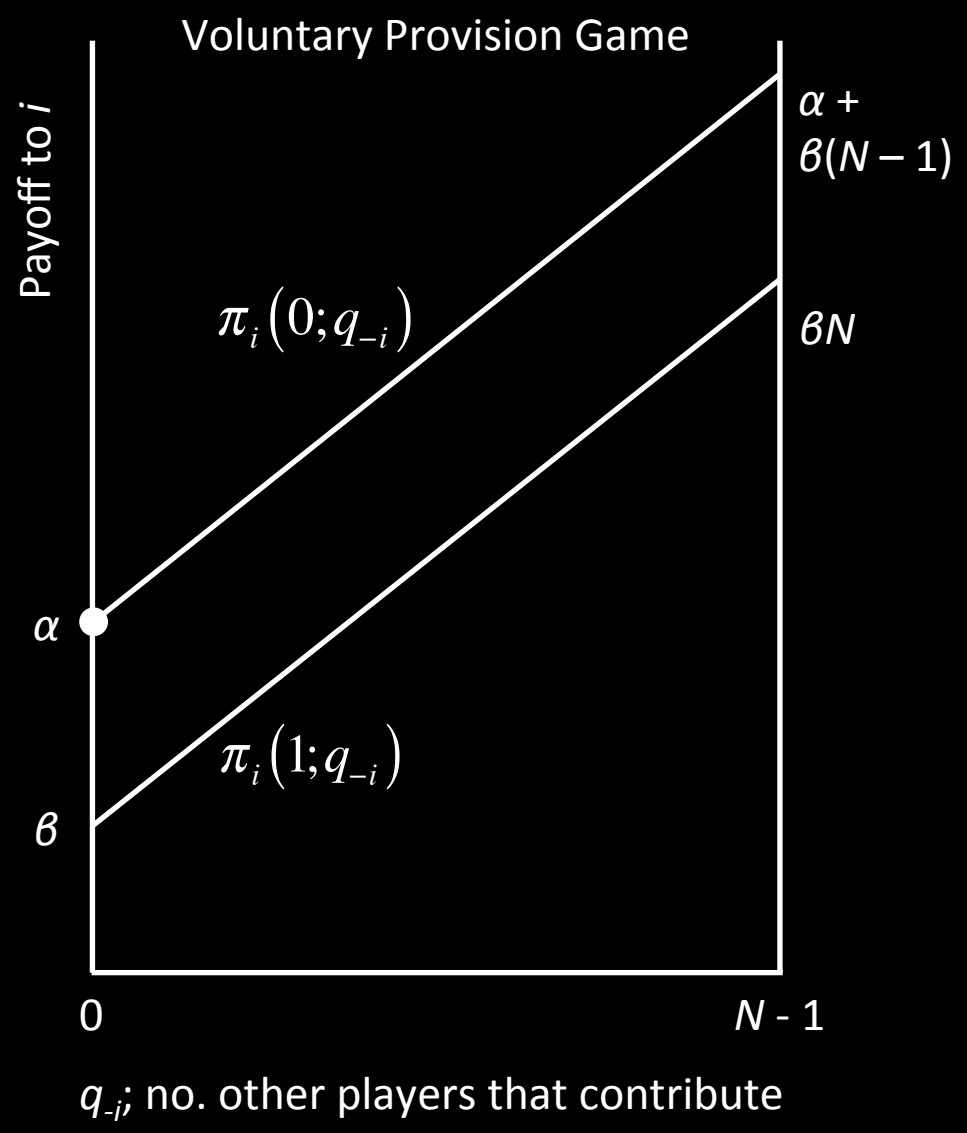
Trade cooperation

- There is an ITA which requires that each party impose zero tariffs on other parties.
- Parties are free to impose a positive tariff on non-parties.
- Non-parties may act as they please.


ITA Game
Payoff to *i*
b(*N* - 1)
$\pi_i(0;h)$
$\pi_i(1;h)$
c(*N* – 1)
0
N - 1
h; no. other players that join the ITA

Climate change game

- Abatement is binary, a global public good.
- Abatement by *i* costs *i* α and gives each country (including *i*) a benefit of β.
- Assume $\beta N > \alpha > \beta > 0$.
- Assume, like Nordhaus, a voluntary provision game.


Voluntary Provision Game
Payoff to i
α +
β(N – 1)
βN
$\pi_i(0;q_{-i})$
$\pi_i(1;q_{-i})$
α
β
0
N - 1
q_{-i}; no. other players that contribute

Linked game

- Subset of countries forms a CTA with each member: (i) supplying the public good; and (ii) imposing a tariff against non-members.
- Non-members: (i) don't supply the public good and (ii) may or may not retaliate against the club members.
- Nordhaus assumes that the players can "commit" not to retaliate. This is implausible. We explore both assumptions.

Linked game: retaliation prohibited

- A player that joins the linked game gets

Benefit of climate abatement by all parties, minus its own cost	+	Benefit of free trade with parties	+	Benefit of imposing tariffs on non-parties

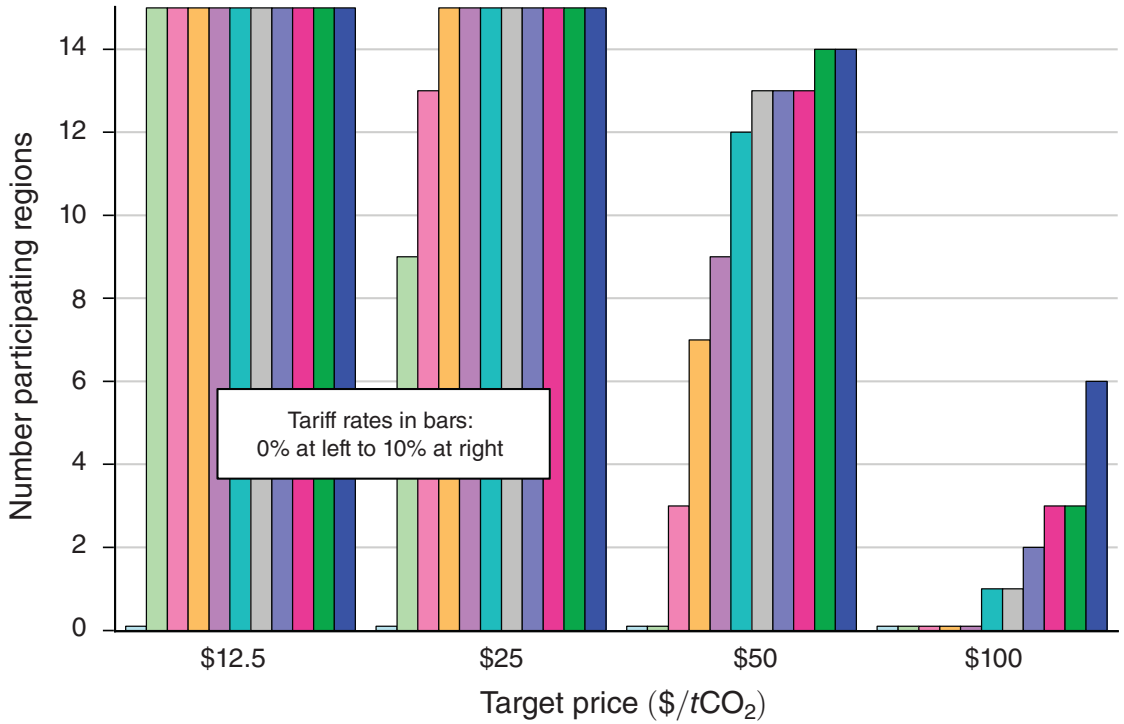
- A player that doesn't join gets

Benefit of climate abatement by parties	+	Payoff of tariffs imposed by parties	+	Benefit of free trade with non-parties

Four possibilities

Condition 1	Condition 2	Game
Gain from climate free riding > Gain from imposing tariffs on non-parties	Gain from climate free riding > Gain from not having tariffs imposed by all others	**Prisoners' dilemma**
Gain from imposing tariffs on non-parties > Gain from climate free riding	Gain from climate free riding > Gain from not having tariffs imposed by all others	**Chicken**
Gain from climate free riding > Gain from imposing tariffs on non-parties	Gain from not having tariffs imposed by all others > Gain from climate free riding	**Coordination**
Gain from imposing tariffs on non-parties > Gain from climate free riding	Gain from not having tariffs imposed by all others > Gain from climate free riding	**Cooperation**

Nordhaus's results again



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Linked game: retaliation allowed

- A player that joins the linked game gets

Benefit of climate abatement by all parties, minus its own cost + Benefit of free trade with parties + "Benefit" of trade war with non-parties

- A player that doesn't join gets

Benefit of climate abatement by parties + "Benefit" of trade war with parties + Benefit of free trade with non-parties

Two possibilities

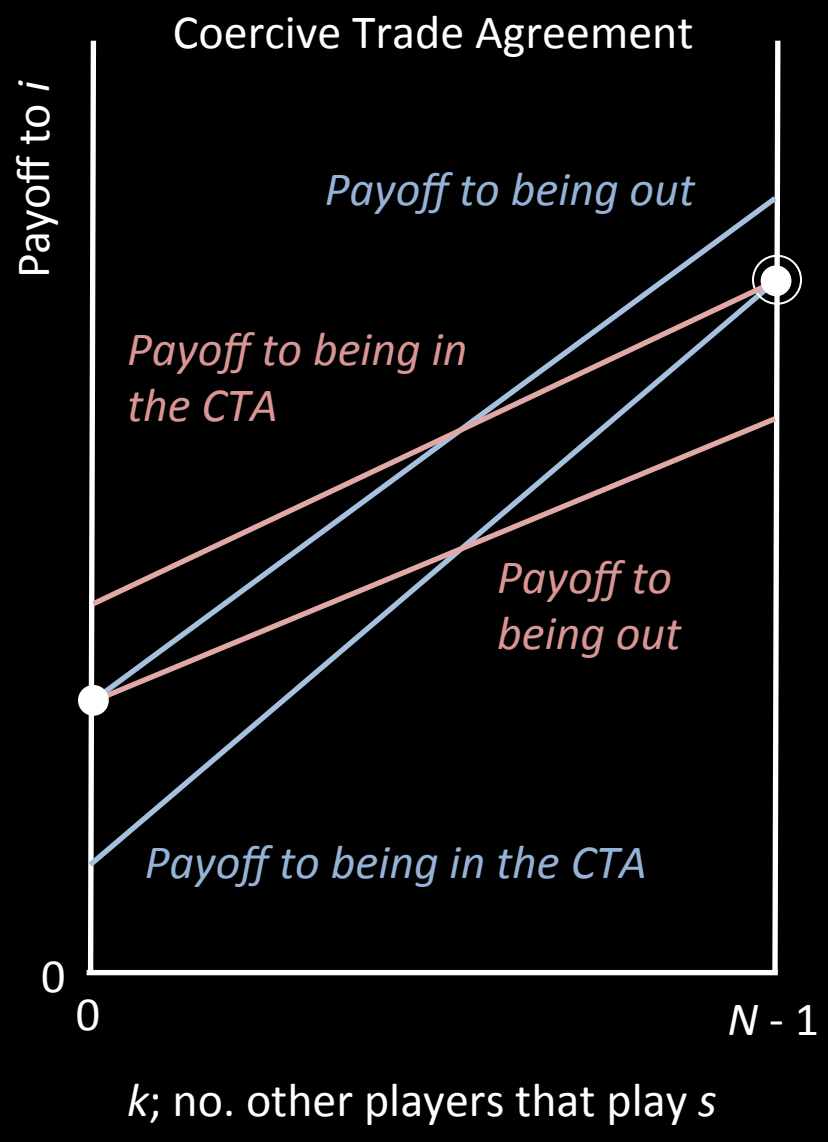
Condition	Game
Gain from climate free riding > Gain from avoiding trade war with parties	**Prisoners' dilemma**
Gain from avoiding trade war with parties > Gain from climate free riding	**Coordination**

Comparison w and w/o retaliation

Retaliation prohibited	Retaliation allowed
Prisoners' dilemma	Prisoners' dilemma
Chicken game	Prisoner's dilemma
Coordination game	Either a prisoners' dilemma or a coordination game, where, in the latter case, the tipping point is higher than when retaliation is prohibited.
Cooperation game	Either a prisoners' dilemma or a coordination game where, in the latter case, coordination on the efficient equilibrium is not assured.

Game to participate in the CTA

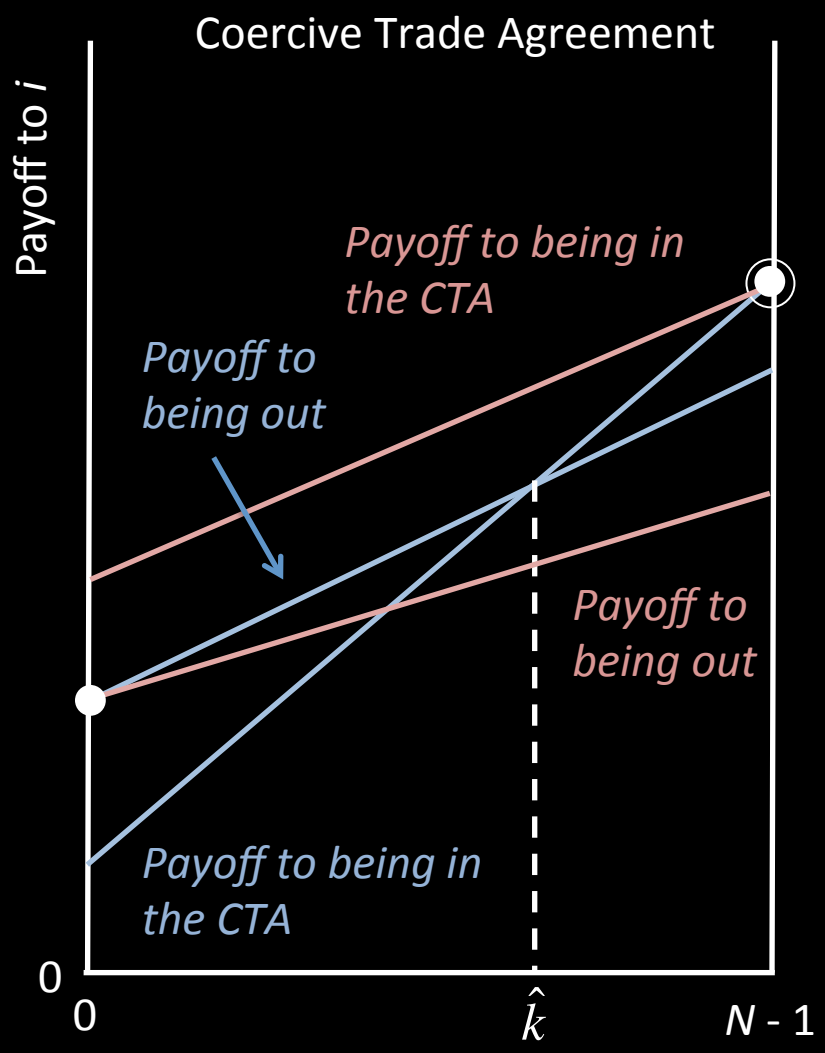
With retaliation prohibited, a cooperation game.



With retaliation permitted, a prisoners' dilemma.

Game to participate in the CTA

With retaliation prohibited, a cooperation game.



With retaliation permitted, a coordination game.

How would groups choose to play?

- Nordhaus solves his model using an evolutionary algorithm, but how would people play this game?
- We consider only the game with retaliation.
- In a "real" situation, a group may:
  - Choose to link and be better off as a consequence.
  - Choose to link and be worse off as a consequence (and, thus, possibly revert to the unlinked game).
  - Choose not to link, even though the group (probably) would have done better by linking.
  - Choose not to link and (probably) be better off as a consequence.

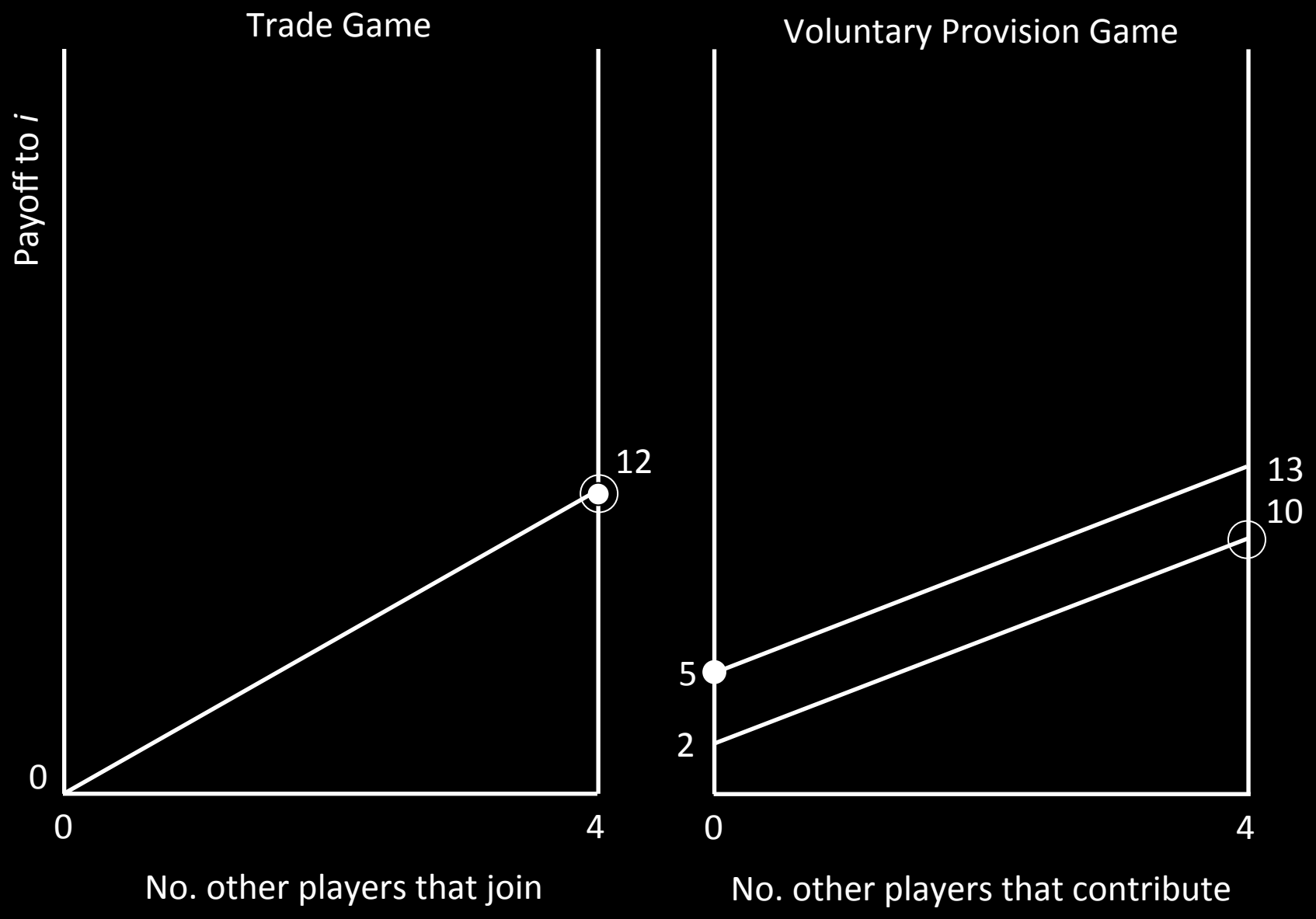
Can test

Can infer

Our experiment

- Assume:
  - $N = 5$, $\alpha = 5$, $\beta = 2$, $c = 0$, $b = 3$.
    - (*We may possibly add a treatment assuming* $b = 1$).
  - Three different institutions, all of which take unlinked game to be the default:
    - **Bottom up**: if at least one country chooses to link, all must play the linked game;
    - **Top down**: if a majority chooses to link, all must play the linked game.
    - **By agreement**: same as above except that the players that vote to link must play *s* if the linked game is chosen.

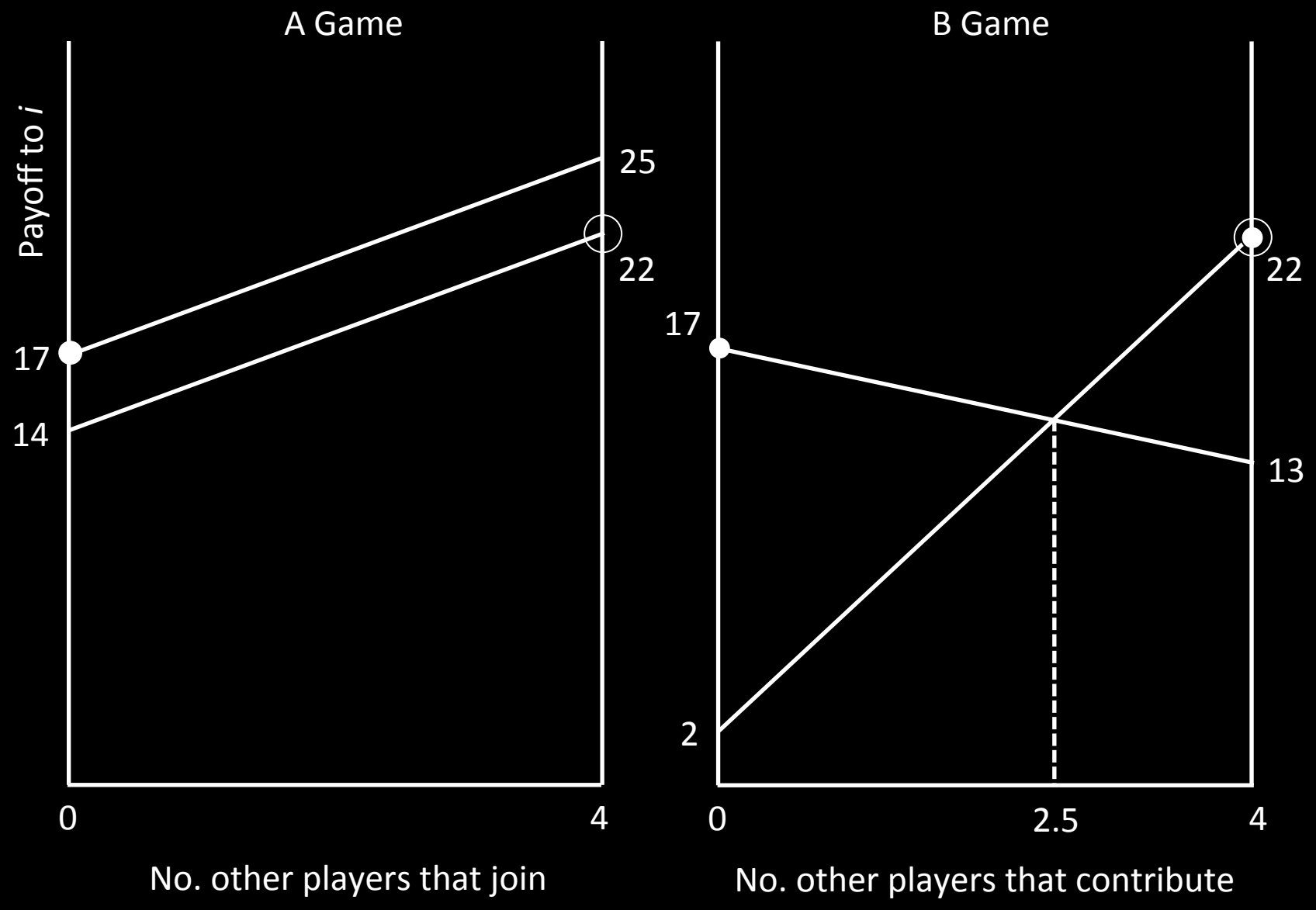
Underlying games



To simplify

- Since cooperation on trade seems almost certain, assume that it can be taken for granted. When the games are unlinked, players therefore get the payoff to trade cooperation plus whatever they get from playing the public good game.
- Because cooperation on trade is so appealing, we also assume that non-members of a CTA do not engage in a trade war with each other.

Unlinked and linked games



Payoffs

Trade	Number of red cards handed in by your co-players				
	0	**1**	**2**	**3**	**4**
Red	0	3	6	9	12
Black	0	0	0	0	0

Climate	Number of red cards handed in by your co-players				
	0	**1**	**2**	**3**	**4**
Red	2	4	6	8	10
Black	5	7	9	11	13

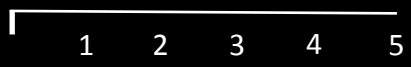
A	Number of red cards handed in by your co-players				
	0	**1**	**2**	**3**	**4**
Red	14	16	18	20	22
Black	17	19	21	23	25

or

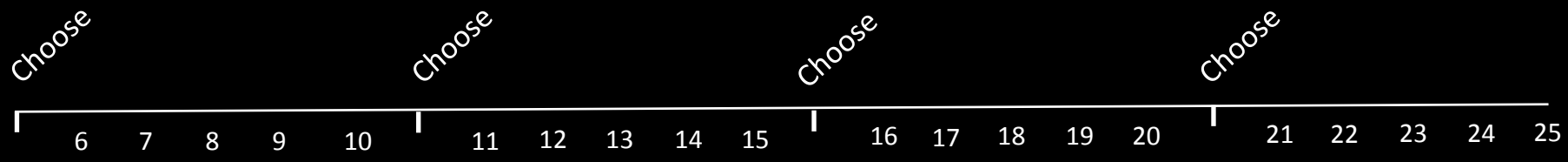
B	Number of red cards handed in by your co-players				
	0	**1**	**2**	**3**	**4**
Red	2	7	12	17	22
Black	17	16	15	14	13

Order of play

Groups of 5 first Play A



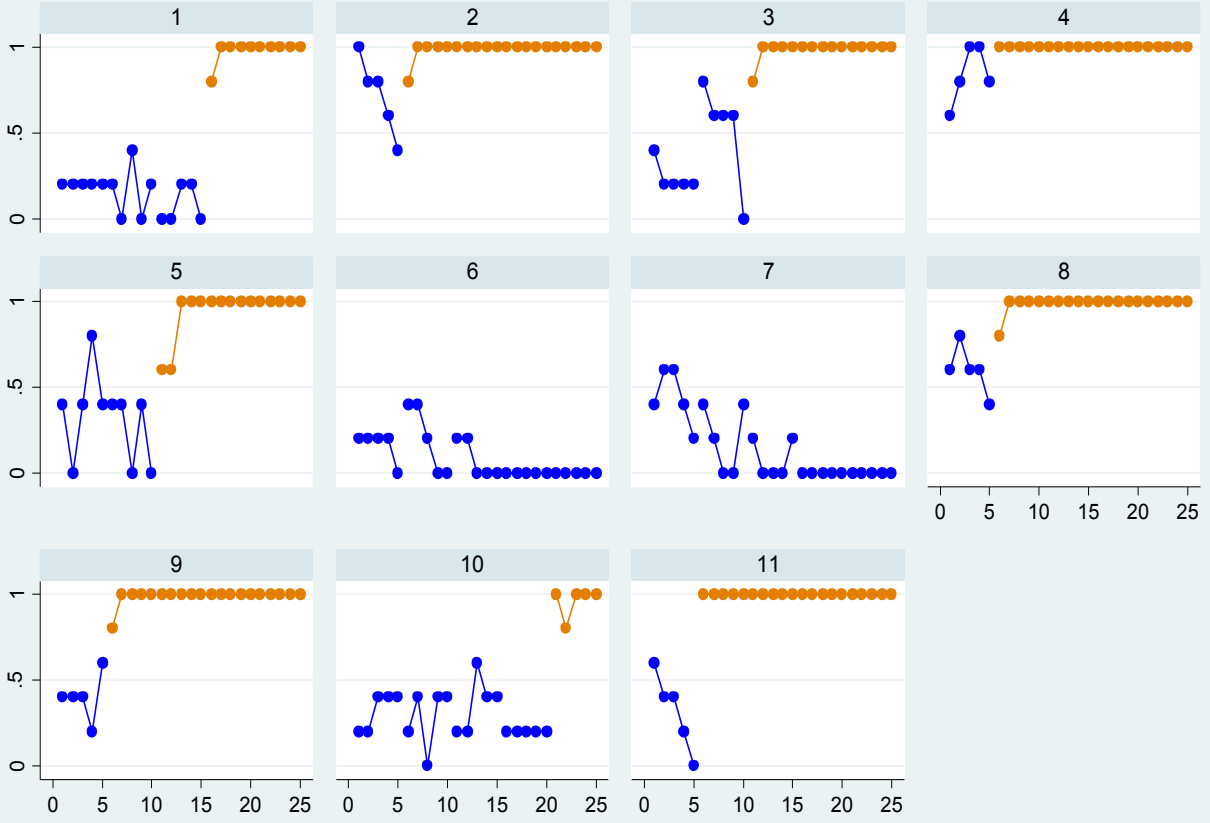
Then they choose between A and B



Preliminary results

- For all treatments, in each phase, groups in B contribute and earn significantly more than groups in A (MWW test)
- Show preliminary results for *Agreement* only.

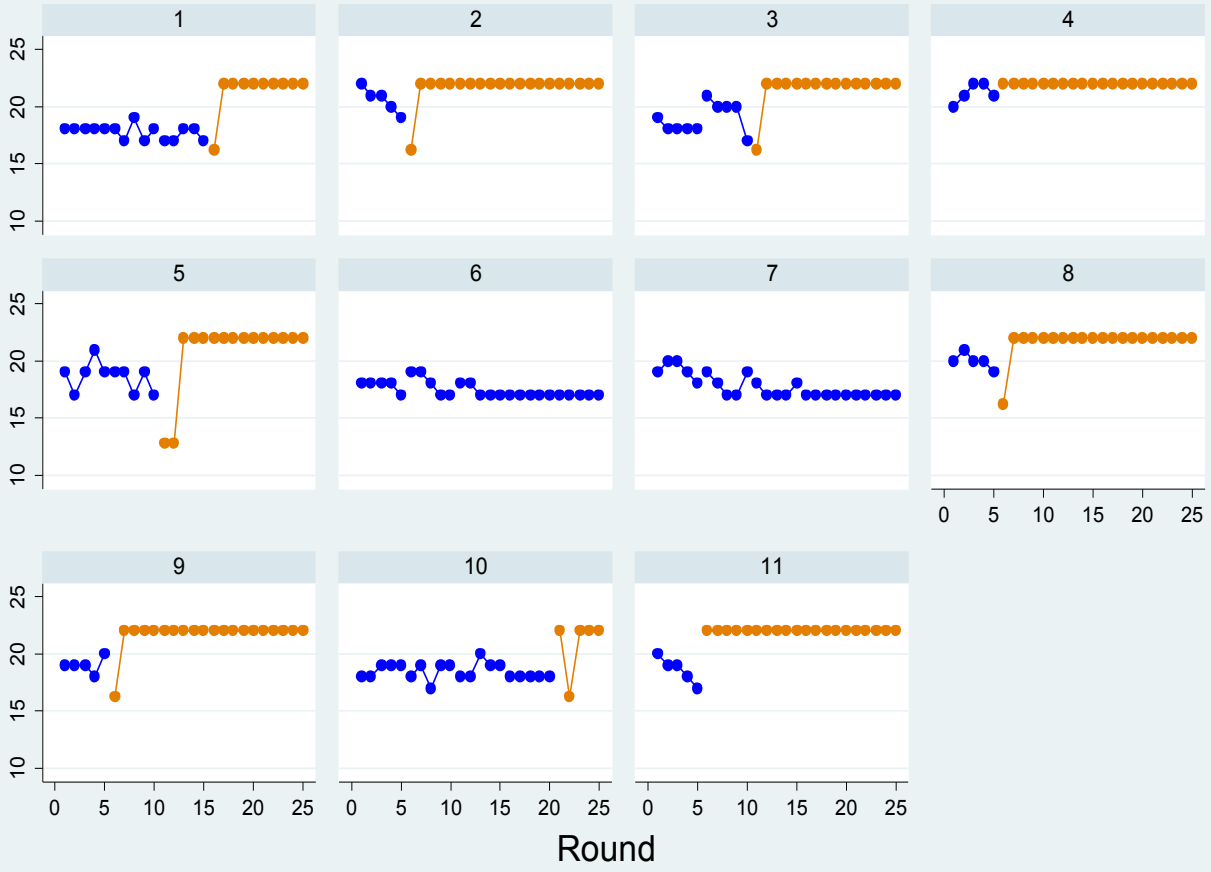
Contributions by group: *Agreement*



Blue = A Orange = B

A has one Nash equilibrium. B has two pure strategy Nash equilibria.

Payoffs by group: *Agreement*



Blue = A Orange = B

A has one Nash equilibrium with payoff 17. B has two pure strategy Nash equilibria with payoff 17 and 22.

Summary

- Nordhaus shows that linkage may help, but only if the tax is low and the tariff high.
- He doesn't reveal the games behind his results. His retaliation assumption is questionable.
- We show that, because of the risk of retaliation, linkage is even less attractive as an option than suggested by Nordhaus.
- Moreover, when linkage can help, it requires coordination, which isn't easy. What institutional rule should be used, "bottom up" or "top down"?
- Can people be relied upon to choose wisely?