Coercive Trade Agreements for
Supplying Global Public Goods

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We develop a model of cooperation on trade and (in keeping with the Paris Agreement) of voluntary cooperation on climate change, and ask whether it is better to keep these issues separate or to link them, by making cooperation on trade conditional on supplying the global public good of reducing greenhouse gas emissions.

Nordhaus (2015) has shown that, depending on the social cost of carbon and tariff level, linkage may enable countries to cooperate fully on both trade and climate change, or it may only sustain partial cooperation on both issues, or it may be of no help at all. However, his approach is numerical, and conceals the full nature of the games being played. Moreover, Nordhaus assumes that all countries commit in advance not to retaliate against members of a "Climate Club" that impose punitive tariffs on non-members.

Our simple model reveals the full nature of the linked game and the consequences of this assumption about retaliation. We show that if retaliation is prohibited, then linkage gives rise to four possible situations (for any given set of parameter values, only one of these situations will exist): a cooperation game, a coordination game, a chicken game, or a prisoners' dilemma. By contrast, if retaliation is a choice, linkage gives rise to one of only two possible situations (again, depending on parameter values): a coordination game or a prisoners' dilemma. We also find that the conditions that enable linkage to increase cooperation on climate change are more restrictive than suggested by Nordhaus. Moreover, we show that even when linkage could improve climate cooperation, its adoption is not assured, because the payoff dominant Nash equilibrium of the coordination game cannot also be risk dominant. This in turn means that the *institution* for determining whether to link is crucial.

In Nordhaus's paper, the decision to link is made by a computer algorithm. In our paper, the decision to link is studied in the lab. Our experiments focus only on the restricted set of circumstances in which linkage could theoretically be helpful—that is, when linkage implies a coordination game rather than a prisoners' dilemma. The important questions are thus, (i) whether players would choose to play the linked game and (ii) whether, when they play the linked game, the players succeed in coordinating on the mutually preferred Nash equilibrium.

Our experiments involve six treatments. One-half of the treatments are for a world in which the gains to cooperation on trade are high relative to the gains to

cooperation on climate change. These are the *High* treatments, for which the "tipping point" in the coordination game is relatively low. The other one-half of the treatments are for a world in which the gains to cooperation on trade are low relative to the gains to cooperation on climate change. These are the *Low* treatments, for which the tipping point in the coordination game is relatively high. The *High* and *Low* treatments are examined under three different institutions for deciding whether trade and climate cooperation are linked. Under the *Single* treatments (*Single-High* and *Single-Low*), if one or more players decide to link, all players must play the linked game. Under the *Majority* treatments (*Majority-High* an *Majority-Low*), a (possibly super) majority of players must vote to link in order for all players to play the linked game. Finally, under the *Agreement* treatments (*Agreement-High* and *Agreement-Low*), a (possibly super) majority of players must vote to link in order for all players to play the linked game, with the yes-voters then being committed to supplying the public good. This last institution is suggested by the theory of international environmental agreements.

Our experiments show:

1. Linkage is not always tried;
2. When linkage is tried, players sometimes fail to coordinate.
3. Linkage is both more likely to be tried and more likely to pay off if the gains to cooperation on trade are *High* relative to the gains to cooperation on climate change.
4. If the gains to cooperation on trade are *High* relative to the gains to cooperation on climate change, all institutions do relatively well.
5. If the gains to cooperation on trade are *Low* relative to the gains to cooperation on climate change, the institution of *Agreement* is generally to be preferred as it leads to higher average payoffs compared to *Single* and *Majority*.
6. Overall, the chances of linkage sparking a trade war are greater under *Low* than under *High* and greater under *Single* than under *Majority*. Under *Agreement*, the chances of linkage sparking a trade war are very low *by design*.
7. If it were not known whether the gains to cooperation on trade were *High* or *Low*, *Agreement* would be the best overall choice of institution.

To sum up, our paper shows that the strong likelihood of retaliation restricts the set of circumstances in which linking cooperation on trade to cooperation on climate change is welfare-improving. When these circumstances are favorable in theory, the opportunity to link may not be seized (even though, had the opportunity been seized, linkage could possibly have made countries better off). More worryingly, coordination may fail, given that linkage is attempted. However, as the latter risk can be minimized by careful design of the linked treaty, the case for linkage ultimately depends on the empirical question of whether the linked game is a coordination game and not a prisoners' dilemma.