TRADE SANCTIONS AND THE STABILITY OF INTERNATIONAL ENVIRONMENTAL AGREEMENTS

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Overview

In spite of scientific agreement on the negative effects of anthropogenic climate change, efforts to find cooperative solutions at the international UN climate negotiations have been unsatisfactory so far. Game theoretic strands of economic literature have studied the formation and stability of international environmental agreements (see Marrouch and Ray Chaudhuri (2016) for an overview) and found that it is difficult to reach stable coalitions due to freerider incentives. Recent extensions of the game theoretic literature include inter alia multiple agreements (Hagen and Eisenack (2015)) or minimum participation constraints (Weikard et al. (2015); Carraro et al. (2009)). Trade policies as complementary measures in sub-global climate policies – in the form of border carbon adjustments – have been thoroughly studied as a measure to overcome drawbacks of unilateral carbon pricing associated with carbon leakage[1] – for overview articles see Böhringer et al. (2012) and Branger and Quirion (2014). Recently, the focus has shifted towards the idea of using trade measures not as means to improve sub-global policies, but as a stick to incentivize cooperation.[2] Nordhaus (2015a) draws on the theory of club goods in his proposal for a mechanism that may help to stabilize an international environmental agreement that he calls 'climate club'.[3] The proposed mechanism uses trade sanctions – uniform import tariffs – against non-members to increase cooperation and stabilize the climate agreement. From simulations with the C-DICE model[4] he concludes that prospects for international cooperation increases substantially when abating regions impose trade sanctions against non-participants.

In this paper, we pick up Nordhaus' policy scenarios and challenge his findings on two grounds to test if his main conclusion remains robust. First, although the basic mechanism to foster cooperation is welfare changes through trade policy, Nordhaus argues that including a full international trade model is unnecessarily complex. Instead he uses what he calls "reduced-form tariff benefit functions" to represent regional welfare changes induced by tariffs in his C-DICE model. These functions are calibrated using a trade model by Ossa (2014). In this paper, we use a multi-sector, multi-region CGE model with Armington trade structure, where regional and global welfare effects due to policy interference is fully endogenized. Second, Nordhaus' results rely on the assumption that non-members are not able to response to tariffs by members, assuming the treaty would prohibit retaliation. We allow for scenarios in which non-members can choose to retaliate using uniform tariffs.

Methods

We use a standard multi-region, multi-sector computable general equilibrium (CGE) model of global trade and energy use based on the model used in Böhringer et al. (2015). Each region features a representative agent who receives income from primary factors and maximizes welfare subject to a budget constraint. International trade is modeled following Armington's differentiated goods approach, where goods are distinguished by origin (Armington (1969)). Carbon dioxide emissions are linked in fixed proportions to the use of coal, oil, and gas. All production and consumption activities are represented through nested constant elasticity of substitution functions. For model calibration we use the latest version of the GTAP database (Version 9) with base-year 2011 (Narayanan et al. (2015)), as well as exogenous estimates for fossil fuel supply elasticities. The database is aggregated to reflect the regional resolution of Nordhaus' study.

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[1] Carbon leakage is the relocation of emissions triggered by climate policies.

[2] Böhringer et al. (2016) use a static computable general equilibrium (CGE) model and set up a game between a coalition that is going forward with carbon pricing and non-coalition regions. The coalition can use carbon tariffs against the non-coalition. Non-coalition regions can either join the coalition, retaliate, or do nothing. They show that – even under the threat of retaliation – trade measures can spur prospects for cooperation. However, they do not use a concept of internal stability of the climate coalition.

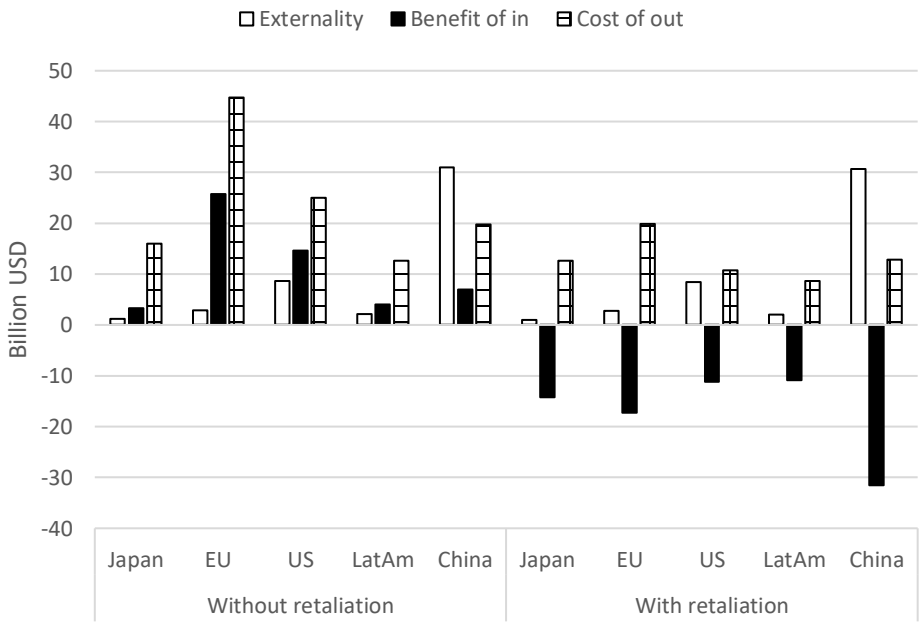
[3] Note that there exist other definitions of the concept of climate clubs – see e.g. Weischer et al. (2012), Widerberg and Stenson (2013) and Hagen and Eisenack (2015).

[4] See Nordhaus (2015b).

Preliminary Results

Our first set of preliminary results suggests that Nordhaus' reduced-form tariff benefit functions work fairly well compared with a standard CGE framework with Armington-type international trade. Considering retaliation by non-members, however, changes the picture. Figure 1 shows for all model regions the "externality", the "benefit of in", and the "cost of out" at an assumed social cost of carbon of 25 USD for the cases with and without the option to retaliate.[5] If we focus on the results without retaliation[6], the major difference to Nordhaus' results is that the "cost of out" is substantially higher in our case. This is an indication that tariffs might foster cooperation even stronger in the Armington-CGE structure compared to C-DICE. With the option to retaliate, the picture changes markedly. Here, the "benefit of in" is negative for all model regions, showing that an introduction of tariffs leads to welfare losses if other regions can choose to retaliate and introduce tariffs themselves. Also, the "cost of out" is roughly halved for most regions. Our preliminary results indicate that considering retaliation could substantially lower the appeal of tariffs as a strategic means to incentivize cooperation.

Figure 1: "Externality", the "benefit of in", and the "cost of out" at an assumed social cost of carbon of 25 USD



Preliminary Conclusions

In this paper, we pick up the analysis in Nordhaus (2015) and challenge his findings on two grounds. First, given that the basic mechanism to foster cooperation is welfare changes through trade policy, we use a multi-sector, multi-region CGE model with Armington trade structure, where regional and global welfare effects due to policy interference is fully endogenized. Second, we allow non-members who are faced with tariffs to retaliate.
Our first set of preliminary results suggests that tariffs might foster cooperation even stronger in the Armington-CGE structure compared to C-DICE. With the option to retaliate, the incentive to cooperate is reduced markedly. Our preliminary results indicate that considering retaliation could substantially lower the appeal of tariffs as a strategic means to incentivize cooperation.

Research is ongoing and our next step will be to formalize our considerations in an analytical framework and to quantitatively assess the stability of possible coaltitions with and without retaliation by non-members.

[5] These concepts are taken from Nordhaus (2015a) in order to compare results:
- "Externality" quantifies the external damage of a regions emissions, i.e. Emissions times the difference of the global social cost of carbon and the national social cost of carbon.
- "Benefit of in" is the welfare change of a region if it forms a club of 1. In the absence of retaliation this means in fact a unilateral introduction of tariffs in a particular region against all other regions. With retaliation, this means introducing tariffs but also being subject to tariffs by all other regions.
- "Cost of out" is the welfare change of a region if it leaves the grand coalition. In the absence of retaliation this means begin subject to tariffs by all other regions. With retaliation, regions can additionally impose tariffs on all other regions themselves.

[6] This is precisely the setting in Nordhaus (2015a).

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