Workshop Developments in Energy Economics

Measures to Enhance the Effectiveness of International Climate Agreements: The Case of Border Carbon Adjustments

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The model

The paper studies the formation of an IEA using a intra-industry trade model with product differentiation and n *ex-ante* symmetric countries.

There are n firms, one in each country, that compete in quantities.

Markets are segmented and each firm supplies its variety to the domestic and all foreign markets according to the consumer $i's$ inverse demand function for country $k's$ variety

$$p_{ik} = a - (1-\gamma)q_{ik} - \gamma Q_i, \quad Q_i = \sum_{k \in N} q_{ik}, \ \gamma \in [0,1].$$

Thus, we have that in each country there are n markets.

Production costs and environmental damages are linear.

Signatories choose the emission tax rate (output tax) to maximize the net social welfare of the agreement under two regimes: No-BCA and BCA.

Under BCA, the tariffs are chosen such that the effective tax on imports is the same as the tax on domestic production.

Main results (based on numerical simulations)

Result 2 - Equilibrium Coalitions under Open Membership

No-BCA

$$m^*(\text{signatories}) = 3/10,\ \gamma = 0,\ \text{Closing the gap index} = 7.3\%$$

BCA

$$m^* = 10/10,\ \gamma = \{0.5, 1\},\ CGI = 100\%.$$

$$CGI(m^*) = \frac{\sum_{k\in N} W_k(m^*) - \sum_{k\in N} W_k(m=1)}{\sum_{k\in N} W_k(m=n) - \sum_{k\in N} W_k(m=1)} 100.$$

No-BCA	**BCA**
Positive externalities	Positive externalities, $\gamma = 0$
-	Negative externalities, $\gamma = \{0.5, 1\}$
Superadditivity, $\gamma = \{0, 0.5\}$	Supperadditivity
$W_{i\in S}(m) < W_{j\notin S}(m),\ \forall m$	$W_{i\in S}(m) < W_{j\notin S}(m),\ \uparrow m,\ \gamma = 0$
Cohesiveness	Partial cohesiveness

Comments

i) The paradox of cooperation: stable agreements are either small, shallow or both whenever the gains from cooperation would be larger.

The CGI is not a good index to check the paradox of cooperation. What is relevant is the magnitude of the denominator. A high CGI is compatible with small gains from cooperation.

ii) The numerical simulation considers three values for $\gamma = \{0, 0.5, 1\}$ but each value is supporting different market structures: monopoly ($\gamma = 0$), monopolistic competition ($\gamma \in (0, 1)$) and oligopoly with an homogeneous product ($\gamma = 1$). Moreover, it is clear that some properties of the game depends critically on the value this parameter takes. For instance, positive versus negative externalities of cooperation.

I wonder whether it would be better to focus only on monopolistic competition assuming values for γ in the open interval $(0, 1)$. For instance, $\gamma = \{0.25,\ 0.50,\ 0.75\}$. Maybe in this case the properties of the game for the two regimes studied in the paper would not depend on γ but only on the policy applied by the governments.

iii) For $\gamma = 1$ all the firms are producing the same good but it is assumed that the markets are segmented and the transportation costs are zero. This is difficult to justify, so eliminating $\gamma = 1$ from the simulations would avoid this concern.

iv) "..., if the value of the parameter a is high compared to the value of the parameters c and δ, ... taxes may even be negative, i.e. governments subsidize their firms...For $\gamma = 1$, one can show that $t_i^*(m) > t_j^*(m)$ and $t_j^*(m) < 0$ always hold whereas $t_i^*(m)$ can be positive or negative without violating the non-negativity constraint *on emissions*." (p. 18)

This makes economic sense since the market is inefficient for two reason, one reason is that production generates a *negative externality*, the other reason is that firms have *market power*.

The problem is: may we to propose a subsidy on emissions as the optimal environmental policy to apply by a climate agreement?

Martín-Herrán and Rubio (2018). "Second-Best Taxation for a Polluting Monopoly with Abatement Investment." Second AERNA Workshop on Game Theory and the Environment, Madrid, 2017.

The steady-state optimal tax rate is negative regardless of the importance of environmental damages.

v) In the standard two-stage game of coalition formation if damages are linear, optimal emission are a dominant strategy. Non-signatories choose the same level of emissions whatever are signatories' emissions. I wonder whether this property could give in your model a higher weight into the analysis to the *market* strategic interdependence than to the *climate* strategic interdependence. Should we expect the same type of results for increasing marginal damages originating a stronger carbon leakage?

vi) The analysis of the properties of the games under the two regimes studied in the paper is excellent but I miss the analysis of the strategic relationship between taxes. Are the taxes strategic complements or strategic substitutes? Does this relationship change when BCA are applied? Is it relevant to explain the level of cooperation?

vii) Methodological question: partial versus general equilibrium model.

The problem with the partial equilibrium models is that CO_2 emissions are not industry-specific, i.e. emission are produced by different firms that belong to different industries as well as by transportation and consumption activities.

On the other hand, it is difficult to capture the strategic interaction between signatories and non-signatories in a game-theoretic sense in general equilibrium models.

References

The list of references is excellent. Nevertheless, the authors could take into consideration the following papers:

Helm, Carsten and Robert Schmidt (2015) EER

Nordhaus, William (2015). "Climate Clubs: Overcoming Free-Riding in International Climate Policy." *American Economic Review*, 105, 1139-1370.

C. A Sketch of the Climate Club

The agreement envisioned here centers on an "international target carbon price" that is the focal provision of an international agreement.

A key part of the club mechanism (and the major difference from all current proposals) is that nonparticipants are penalized. The penalty analyzed here is uniform percentage tariffs on the imports of nonparticipants into the club region. Calculations suggest that a relatively low tariff rate will induce high participation as long as the international target carbon price is up to $50 per ton.