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Carbon tariffs and cooperative outcomes

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HIGHLIGHTS

- One of the first studies to consider border-tax adjustment in a strategic context.
- Border-tax adjustment can lead to an optimal outcome, in cooperative sense.
- Optimal outcome is achieved with partial tax adjustment.

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ABSTRACT

In the absence of an international environmental agreement (IEA) on climate change, a country may be reluctant to unilaterally implement environmental actions, as this may lead to the relocation of firms to other, lax-on-pollution countries. To avoid this problem, while still taking care of the environment, a country may impose a carbon tariff that adjusts for the differences between its own carbon tax and the other country's tax. We consider two countries with a representative firm in each one, and characterize and contrast the equilibrium strategies and outcomes in three scenarios. In the first (benchmark) scenario, in a first stage the regulators in the two countries determine the carbon taxes noncooperatively, and in a second stage, the firms compete à la Cournot. In the second scenario, the regulators cooperate in determining the carbon taxes, while the firms still play a noncooperative Cournot game. In the third scenario, we add another player, e.g., the World Trade Organization, which announced a border tax in a prior stage; the game is then played as in the first scenario. Our two major results are (i) a border-tax adjustment (BTA) mimics quite well the cooperative solution in setting the carbon taxes as in scenario two. This means that a BTA may be a way around the lack of enthusiasm for an IEA. (ii) All of our simulations show that a partial correction of the difference in taxes is sufficient to maximize total welfare. In short, the conclusion is that a BTA may be used as a credible threat to achieve an outcome that is very close to the cooperative outcome.

1. Introduction

A challenging problem for a country contemplating the introduction of a unilateral environmental policy, e.g., taxing pollutants or imposing emissions standard, is how to keep its local firms competitive. Indeed, since any environmental policy may increase production costs, at least in the short term, firms operating in environmentally lax countries gain a competitive advantage, and local firms are tempted to relocate to such countries. This phenomenon is referred to in the literature as the pollution-haven hypothesis (PHH), see, e.g., Copeland and Taylor (1994), Sheldon (2006) and Levinson and Taylor (2008).

A more troubling outcome would be that the emissions from the production going abroad would cancel out the reduction in carbon emissions in the abating country because of the less environmentally friendly technologies being used in the lax country.[1] For example, a firm moves to a country that uses coal for energy instead of hydroelectricity. Leakage rates have been widely studied and some find results close to 2%, while most studies find leakage rates between 5% and 20%.[2] Carbon leakage is typically separated in multiple channels, where the two main channels are the energy prices channel and the competitiveness channel. The energy prices channel relates to an increase in the foreign demand of polluting products following the decrease in the demand of the countries adopting an environmental policy,

[1] For carbon leakage to occur, the emissions reduction does not need to be cancelled out but rather emissions abroad increasing due to this environmental policy is carbon leakage.

[2] For more on this, see Zhou et al. (2010).

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and thus a decrease in its world price. The competitiveness channel relates to an increase in foreign emissions because domestic firms are shifting its production to a country with less environmental stringency. The bleak dual outcome for abating countries is then a loss of competitiveness and a large increase in *foreign* emissions. In an extreme carbon leakage context, very few countries would be tempted to adopt an environmental policy.[3] Even if the other countries also engage in setting carbon prices, there may still be opportunities for arbitrage due to differences in their levels.[4] One proposal that has been discussed over the years is the introduction of a carbon tariff, also known as a carbon-motivated border-tax adjustment (BTA), which would impose a tariff to compensate for the difference in taxes and give a subsidy on exports going to a country with a less stringent environmental policy. As a BTA may potentially be viewed as a protectionist measure, a requirement for its implementation is its acceptance by the World Trade Organization (WTO). There is a significant literature advancing reasons why a BTA should be allowed under the WTO (see, e.g., Ismer and Neuhoff, 2007; Cendra, 2006; Pauwelyn, 2007; Weber and Peters, 2009). For instance, Ismer and Neuhoff (2007) suggest using a best-available-technology (BAT) rule whereby a unit of product would be taxed in accordance with the emissions released in the country with the lowest emissions ratio in place. Similarly Mattoo et al. (2009), look at implementing BTAs with respect to carbon content in imports versus using carbon content in domestic production. They believe it would seriously address competitiveness concerns in high-income countries without significantly hurting developing-country trade. They suggest that WTO rules may prohibit BTA based on embodied carbon content but allow for domestic carbon content BTA. Monjon and Quirion (2010) discuss the design of a border adjustment (BA) applied to European Union. The authors believe that we must be wary of using the BAT because we may not have an appropriate tax level. Certain technologies such as producing metals with hydropower should be excluded; otherwise the level of the BA may be too low. They propose that the easiest way to define the BAT is to use the product-specific benchmarks for goods at risk of carbon leakage, which are determined by the European Commission. These benchmarks are computed based on the average emissions of the 10 percent least carbon-intensive European plants.

This paper is a follow-up to Eyland and Zaccour (2012), where we assessed the impact of an *exogenous* BTA on welfare in a two-country model. Contrary to the literature using computable general equilibrium (CGE) models (e.g., Dissou and Eyland, 2011; Fischer and Fox, 2009), where one country adopts a BTA and only looks at its impacts, Eyland and Zaccour (2012) allow for a strategic reaction from the other country, as advised by Ludema and Wooton (1994). Further, we found that a partial adjustment may lead to higher welfare than a full adjustment.

In a two-country framework, our objectives are to endogenize the border-adjustment tax and to answer the following research questions:

1. What is the BTA value that maximizes total welfare?
2. Is it always in the best interest of the abating country to see a BTA imposed?
3. Can a BTA mimic an environmental agreement in which the two countries cooperatively set their carbon taxes?

The answer to the first question will offer a hint to international agencies (e.g., WTO) on what would be a suitable interval for a BTA. The answer to our second question will provide a guideline for an abating country on when to lobby for a BTA, and when it is better to keep quiet. Finally, the third question addresses the issue of the decentralization of a collectively optimal policy through BTA.

To deal with these questions, we shall compare the outcomes of three games, namely, a noncooperative game (benchmark), a cooperative game under taxation, and a noncooperative game with a BTA.

The rest of the paper is structured as follows: In Section 2, we introduce the different games. In Section 3, we characterize their equilibria; and in Section 4, we run some simulations to compare the outcomes of the three considered scenarios. Section 5 discusses the robustness of the results and Section 6 concludes.

2. Duopoly model[5]

To evaluate the impact of a border tax on welfare, we developed a model similar to that of Brander and Spencer (1985), to which we add an environmental damage cost and consumer surplus.[6] As mentioned above, this paper builds on Eyland and Zaccour (2012) and mainly adds a stage to the game in which an international body chooses a BTA. As in Brander and Spencer (1985), we have two firms producing a homogeneous good and located in two countries, referred to as the *home* and *foreign* countries. Each country seeks a taxation policy, i.e., a domestic tax or subsidy that may lead to a certain tariff or subsidy on imports, which maximizes its own welfare. Note that throughout the text, the term domestic tax or import tariff may refer to its positive or negative value (subsidy). For the sake of simplicity, without much loss in qualitative insights and still allowing for replication of the cases with a carbon tax only, or a carbon tax with a border-tax adjustment (BTA), we assume in the sequel that there is only a consuming market in *home*.[7]

We subscript with F the *foreign* firm's variables and with H the *home* firm's variables. Denote by q_H the quantity produced by the *home* firm and by q_F the quantity produced by *foreign*. We adopt the following inverse-linear demand:

$$P(q_H, q_F) = \alpha - \beta(q_H + q_F), \tag{1}$$

where $P(\cdot)$ is the price of the good and α and β are strictly positive parameters.

Let $c_j(q_j)$ be the production cost function of firm j, given by

$$c_j(q_j) = \tfrac{1}{2} c_j q_j^2, \quad j = F, H$$

with $c_j > 0$, that is, a convex increasing function satisfying $c_j(0) = 0$. As consumption takes place only at *home* and to save on notation, we suppose that the transportation cost is embedded in $c_j(q_j)$. Further, we assume that the production cost of the *foreign* firm is not higher than that of the *home* firm, i.e., $c_F \le c_H$. This is in line with the idea that *foreign* represents a low production-cost country (e.g., China or India), whereas *home* is a high production-cost country. Note that this assumption is not necessary to characterize the equilibria, but is made only for the sake of interpreting and discussing the results in a realistic context.

[3] As Böbringer et al. (2010) highlight even though energy intensive trade exposed sectors make up for less than 6% of United States emissions and only 10–20% of their total emissions, they are taken seriously because they are very well organized and vocal.

[4] For more on strategic environmental policies see Barrett (1994) and Markusen et al. (1992).

[5] This section draws heavily on Eyland and Zaccour (2012). As mentioned before, the basic ingredients of the model are the same.

[6] In Brander and Spencer (1985), there are two firms from different countries competing à la Cournot in a third country.

[7] Having only one consumer market abstracts from the decision of whether exports from a country with a carbon tax should have a rebate and only focuses on strategic effects of BTAs on taxation policies.