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Robust policies to mitigate carbon leakage

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ABSTRACT

Unilateral climate policy induces carbon leakage through the relocation of emission-intensive and trade-exposed industries to regions without emission regulation. Previous studies suggest that emission pricing combined with border carbon adjustment is a second-best instrument, and more cost-effective than output-based rebating. We show that the combination of output-based rebating and a consumption tax for emission-intensive and trade-exposed goods can be equivalent with border carbon adjustment. Moreover, it is welfare improving for a region that implements emission pricing along with output-based rebating to introduce such a consumption tax. The welfare gain is particularly large if output-based rebating is already implemented for a sector that is not much exposed to leakage, e.g., due to uncertainty about exposure or due to lobbying activities. Thus, supplementing output-based rebating with a consumption tax constitutes robust policies to mitigate carbon leakage.

1. Introduction

In response to the threat of climate change, many countries consider or have introduced unilateral climate policies. However, greenhouse gases are global pollutants and unilateral action leads to carbon leakage, such as relocation of emission-intensive and trade-exposed (EITE) activities to countries with no or more lenient climate regulations. Unilateral constraints on emissions raise production costs for emission-intensive industries such as steel, cement, and chemical products, reducing their competitiveness in the world market, thereby inducing more production and emissions in unregulated regions.

To mitigate counterproductive leakage, countries have either exempted EITE industries from the regulation, or searched for supplemental anti-leakage measures. As a prime example, EITE industries in the EU, which are regulated under an emissions trading system (EU ETS), have received large amounts of free allowances. Currently, allowances are mainly allocated in proportion to installations' production. Free allowances have also been introduced in other emissions trading systems such as in New Zealand, South Korea and California, and in the regional emissions trading systems in China (World Bank, 2014). Free allowance allocation conditional on output can be interpreted as output-based rebating (OBR) of emission tax payments (e.g., Böhringer et al., 1998; Bernard et al., 2007).

Another potential anti-leakage measure that figures prominently in the economic literature is border carbon adjustment (BCA) with carbon tariffs on imports and rebates on exports of EITE goods. Most studies on carbon leakage suggest that BCA outperform OBR with respect to leakage reduction and cost-effectiveness of reducing global emissions (Monjon and Quirion, 2011a; Fischer and Fox, 2012; Böhringer et al., 2014a). BCA are however politically contentious, and experts differ in their views about whether or not it is compatible with WTO rules (see e.g. Horn and Mavroidis, 2011; Tamiotti, 2011; Böhringer et al., 2012b).[1] One signal for its limited political feasibility is that – so far – border measures have only been proposed but not implemented.[2] According to Monjon and Quirion (2011b), a uniform carbon tariff is

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[1] In 2010, the Indian Environment Minister threatened to "bring a WTO challenge against any 'carbon taxes' that rich countries impose on Indian imports" (ICTSD, 2010). There is also a fear that BCA could trigger a trade war (Holmes et al., 2011). On the other hand, Nordhaus (2015) argues that trade penalties can induce countries to join a "Climate Club" (see also Helm and Schmidt, 2015, and Böhringer et al., 2016).

[2] For example, border measures have been included in the American Clean Energy and Security Act of 2009 that passed the U.S. Congress but not the Senate (see https://www.congress.gov/bill/111th-congress/house-bill/2454; Fischer and Fox, 2011). Border measures have also been put forward by the EU Commission (2009) as a possible future alternative to free allowance allocation.

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more likely to be compatible with the WTO rules than tariffs that differentiate between exporting countries.

Regarding economic incentives, a key difference between OBR and BCA is that whereas the latter dampens foreign supply of EITE goods to the regulated country, the former stimulates domestic production. The reason is that OBR acts as an implicit production subsidy (Böhringer and Lange, 2005). As a consequence, production and consumption of EITE goods will be excessive under OBR, compared to second-best setting with BCA.[3] In other words, the incentives to switch from buying emission-intensive to less emission-intensive products are weakened under OBR. As shown in Böhringer et al., (2014a), whereas BCA automatically becomes inactive as the coalition of regulating countries covers the whole world, OBR continues to stimulate too much output of the EITE goods. Similarly, whereas BCA for goods without trade exposure has little or no impacts, OBR triggers too much production.

In this paper we show that it is welfare improving for a country, that has already implemented a carbon tax (or an emissions trading system) along with OBR to EITE goods, to also impose a consumption tax on the same EITE goods. By consumption tax, we refer to product-specific taxes on all purchases of these goods, i.e., not only on final consumption but also on intermediate use in production. The intuition behind the welfare-improving effect of such a consumption tax is that OBR stimulates excessive use of EITE goods. We also find that even in the case without any rebating, it is welfare improving to implement a consumption tax on EITE goods as it reduces foreign production (and hence emissions) of such goods.

The theoretical trade literature has established the result "that a combination of a production subsidy and a consumption tax at equal rates is tantamount to a tariff if the commodity is being imported, and an export subsidy if it is being exported" (Dixit, 1985, p.356). Building on this fundamental idea we show that combining OBR with a consumption tax may be equivalent with BCA (assuming a uniform carbon tariff). The equivalence requires that the consumption tax for an EITE good is equal to the OBR rate, which in turn must equal the carbon tariff and the export rebate.[4] To our best knowledge, this equivalence result has not been shown so far in the context of emission leakage.[5]

For unilateral climate policy design, our finding suggests a viable and probably more robust alternative to contentious BCA,[6] thereby lowering the risk of potentially detrimental trade wars. From a practical point of view, there are no extra administrative costs in determining the consumption taxes as long as benchmarks are already determined for the OBR rates (such as the benchmarks currently used in the EU ETS).

We substantiate our analytical findings with complementary numerical results based on a stylized computable general equilibrium (CGE) model with two regions and four goods, where the goods can be either consumed or used as intermediate input into production. The numerical results are in accordance with our analytical findings. In addition, the simulations demonstrate that the advantage of a consumption tax becomes particularly relevant if the EITE good produced domestically cannot be easily substituted by foreign goods. In this case the potential for leakage is limited, and thus the distortive effects of stimulating output are getting more critical. By combining OBR with a consumption tax, the distortive effect of OBR can be controlled for. Such a strategy becomes particularly policy-relevant if there is uncertainty about leakage exposure for individual sectors. The actual practice in EU climate policy sheds some light on the issue at stake. In the EU ETS, sectors that are "exposed to a significant risk of carbon leakage" receive a high share of free allowances.[7] A majority of industry sectors have been put into this group. In contrast, Sato et al. (2015) find that "vulnerable sectors account for small shares of emission", and Martin et al. (2014) conclude that the current allocation results in "substantial overcompensation for given carbon leakage risk". Note that supplementing OBR with a consumption tax does not only provide a robust strategy against uncertainty on data grounds but also with respect to lobbying activities by industries.

There is a large body of literature on carbon leakage. The seminal paper by Markusen (1975) derives the first-best combination of a domestic emission tax and a tariff on imported goods (in his model, emissions are functions of production only), where the optimal tariff depends on both leakage and terms-of-trade effects. In a similar vein, Hoel (1996) determines an optimal combination of an emission tax and a carbon tariff (or export subsidy), where he also includes the indirect emission effects of the tariff (see also Copeland, 1996, for an early analytical contribution).

Many numerical modeling studies quantify carbon leakage, the bulk of them using multi-region and multi-sector CGE models of the world economy. For policy-relevant parameters on key dimensions – such as the stringency of emission regulation or the size of the abatement coalition – most studies conclude that the leakage rate of a unilateral carbon tax (or emissions trading) is in the range of 5–30%, i.e., a reduction of 100 units of CO_2 in the regulating country leads to an increase of 5–30 units of CO_2 in non-regulating countries (see, e.g., the review by Zhang, 2012, and the special issue edited by Böhringer et al., 2012a). There are, however, a few outliers with negative leakage (Elliott and Fullerton, 2014) or leakage rates above 100% (Babiker, 2005), adopting less conventional assumptions on international factor mobility or market power. Studies that calculate leakage from single EITE industries often find somewhat higher leakage rates (e.g., Ponssard and Walker, 2008, and Fischer and Fox, 2012) since competitiveness losses get relatively more pronounced.

Leakage mainly occurs through two intertwined channels. In this paper we focus on leakage through the market for EITE goods, often referred to as the competitiveness channel. The second channel is the so-called fossil-fuel channel: Reduced demand for fossil fuels in climate policy regions depresses international fuel prices, stimulating fuel consumption and thus emissions in other regions (Felder and Rutherford, 1993). The policy debate focuses on leakage through the competitiveness channel, mirroring concerns of regulated EITE industries on adverse competitiveness effects. The policy focus goes also along with broader scope of policy options – such as BCA or OBR – to mitigate leakage through EITE markets rather than through fossil fuel markets.

Our paper also relates to a strand of literature that examines consumption taxes in environmental regulation, either alone or in combination with other instruments. In particular, Holland (2012) shows that adding a consumption tax to an emission intensity standard can improve efficiency of unilateral climate policy, as standards trigger inefficiently high consumption. Tradable intensity targets can be reinterpreted as a combination of an emission price and OBR – in this respect, Holland's finding is comparable with our result on the efficiency gains through supplemental consumption taxes. However, Holland's model includes only one good, with domestic and foreign goods being homogenous, whereas we consider a model with three different types

[3] This conclusion may no longer hold in the case of pre-existing market imperfections such as market power, see e.g. Gersbach and Requate (2004) and Fowlie et al., (2016).

[4] All instruments are applied in monetary value per unit of the EITE good. For instance, with 100% rebating, i.e., all emission payments from an EITE industry are rebated back to the industry in proportion to firms' output, the equivalence requires that the carbon tariff is based on domestic emission intensities, and that there is 100% export rebating.

[5] Analysis of unilateral climate policy and carbon leakage requires some extensions beyond the well-known basic equivalence mechanism. Specifically, dealing with global pollutants, we need to account for emissions abroad when establishing the equivalence. Our analysis also features endogenous world prices and heterogeneous goods. In a somewhat related context with trade in a homogenous fossil fuel good, Hoel (1994) notes that a climate coalition can improve its terms-of-trade in the fuel market by either introducing an import (export) tariff or a combination of production subsidy (tax) and consumption tax (subsidy) if the coalition is a net importer (exporter) of fossil fuels.

[6] It could be argued that the combination of OBR and consumption tax can also be contentious, as it gives the same outcome as BCA. However, the consumption tax itself should not be contentious as it treats home and foreign firms equally. Another question is whether OBR (or output-based allocation) is WTO compatible, as this favors domestic firms, but such policy has already been implemented as explained above.

[7] http://ec.europa.eu/clima/policies/ets/cap/leakage/index_en.htm.