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# Economic and environmental impact analysis of carbon tariffs on Chinese exports

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ABSTRACT

As an alternative measure for the proposal of border tax adjustments (BTAs) advocated by the countries that seek to abate $CO_2$ emissions (hereafter referred to as 'abating countries'), export carbon tax (ECT) voluntarily conducted by the developing countries has been widely discussed in recent years. This paper uses the multi-regional and multi-commodity computable general equilibrium (CGE) model and the GTAP8.1 database to investigate the economic and environmental effects of carbon tariffs on Chinese exports. The following three policy scenarios are considered: 1) the abating countries implement cap-and-trade emission programs without BTAs; 2) the unilaterally abating countries levy import tariffs and export subsidies on non-abating countries; and, 3) the abating countries implement unilateral climate policies combined with ECT imposed by China. The ECT policy of China is evaluated with a carbon price set at 17 US$/t-$CO_2$. Results illustrate that the ECT voluntarily implemented by China is ineffective in reducing its domestic $CO_2$ emissions. Moreover, ECT merely has a minor impact on global emissions. Finally, the competitiveness of China's energy-intensive and trade-exposed (EITE) industries suffers substantial losses if export tariffs are imposed. However, China's gains in terms of welfare and gross domestic product (GDP) would be slightly improved if an ECT policy is implemented, compared to the scenario where China is subjected to BTAs levied by the abating coalition. In the light of the tradeoff between tariff revenue for welfare and competiveness losses of the EITE industries, it is therefore difficult to conclude that carbon tariff on Chinese exports is an alternative policy to BTAs.



## 1. Introduction

In recent years, two interrelated problems, carbon leakage and international competitiveness, have become central concerns in the domestic discussions in the major developed countries implementing or proposing to implement unilateral emission abating policies. To address these issues, a number of academic studies as well as political debate have proposed the use of border tax adjustments (BTAs) (Antimiani et al., 2013; Böhringer et al., 2012b; Winchester, 2011). BTAs could take several forms, such as taxing imports from unregulated countries based on carbon intensities, or requiring importers to surrender emission allowances under domestic emission trading schemes, or rebating the emission payments for exports to unregulated regions (Asselt and Brewer, 2010; Böhringer et al., 2012b). In the European Union (EU), the European parliament and the council adopted Directive 2009/29/EC on the revision of the EU emission trading scheme (EU-ETS) in phase III in April 2009, which contained several provisions for limiting carbon leakage in EITE sectors. The Directive stipulates that sectors deemed to be exposed to carbon leakage can receive free allocation of allowances. It also allows for some forms of border carbon adjustments to support certain EITE industries, which are identified as being exposed to a significant risk of carbon leakage. Nevertheless, although the revised Directive includes a notion of comparability of mitigation efforts, it does not specify how this comparability is to be determined (European Commission, 2009). Similar proposals are also being discussed in the United States (U.S.). The Waxman–Markey–Bill (H.R. 2454) was approved by the House of Representatives in 2009 but later it was defeated in the Senate. The bill includes some provisions on border tariffs for the carbon-intensive products from countries without comparable actions to reduce emissions. However, much like the EU, it does not include a definition of comparable action either. Instead, the bill follows the basic logic from other bills by including the following standards for tariff exemption: 1) a country has an economy-wide emission cap at least as stringent as that of the U.S.; 2) there is a sectoral bilateral or multilateral agreement with the U.S.; or, 3) it has a lower sectoral energy or greenhouse gas intensity than the U.S. (Asselt and Brewer, 2010). The debate on trade-based anti-leakage measures has been echoed by the other abating countries, such as Australia, New Zealand and Canada (Marcu et al, 2013). The motivation behind adopting BTAs by the regulating countries is to induce the major emitting developing countries, especially China and India, to participate in the future climate regime. While BTAs have

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theoretical appeal on global efficiency grounds, their induced distributional impacts have attracted controversy. BTAs initiated by developed countries are criticized to shift the economic burden of carbon emission reduction from the abating countries to the unregulated countries (Böhringer et al., 2012b).

China has overtaken the U.S. to become the largest emitter of greenhouse gases (GHG) since 2007, yet it is not subject to the quantified emission limitation and reduction commitment under the current international climate framework. Both the international debates on BTAs and their domestic problems relating to environmental and energy security exert pressure on China to take action to reduce emissions (Li et al., 2012). In 2009, the Chinese government pledged to achieve its national target on climate change, which includes a reduction of the intensity of $CO_2$ emissions per unit of GDP by 40–45% by 2020, compared to the 2005 level. In addition, since 2011, China has initiated carbon-trading pilots in seven provinces and cities. However, unlike most existing 'absolute' cap-and-trading emission systems, the target adopted by China is a carbon intensity-based one. Moreover, there is lack of market-based instruments for the enforcement of ETS in China. Consequently, it is still unclear whether the total carbon emissions of China will be reduced or not (Han et al., 2012). Since exports have become a major contributor to economic growth of China in recent years (Liu et al., 2002; Shan and Sun, 1998), BTAs imposed by the abating coalition are supposed to directly affect China's international trade and substantially influence the whole economy through decreases in domestic production and consumption (Tang et al., 2013). As a matter of fact, China has implemented restrictive policies on energy-intensive exports in the form of 'export value-added tax refund rebate and export tax' since 2007. In the 2012 report on China's policies and actions for addressing climate change, the government emphasized that it has vigorously controlled the exports of high-energy-consumption products (IOSC, 2012). Although these restrictive export policies have mainly served for China's domestic development strategies so far, some analysts have proposed to implement an explicit export carbon tax (ECT) in China, which will entail advantages at the international level (Andersen and Ekins, 2009; Hűbler, 2012; Li et al., 2012; Wang et al., 2012). First of all, the ECT of China can be seen as an alternative measure to the BTAs levied by the developed countries, in that it may help to lessen the abating countries' concerns about carbon leakage and competitiveness losses. In addition, export tariffs can generate a significant revenue flow for developing countries, thus alleviating the adverse economic impact of the BTAs by the abating coalition.

The literature to date related to BTAs has mainly focused on quantifying the extent of competitiveness effects and the scope of carbon leakage under different implementation scenarios of carbon tariffs in developed countries (e.g., Böhringer et al., 2012b; Kuik and Hofkes, 2010; Mckibbin and Wilcoxen, 2009; Takeda et al., 2012). For example, using the GTAP-E model, Kuik and Hofkes (2010) explored the implications of BTAs in the EU-ETS. Their results suggest that the reduction of the overall or macro rate of carbon leakage would be modest. They consequently argued that BTAs would not be a very effective policy to reduce carbon leakage but might mainly be justified in relation to sectoral competitiveness. Mckibbin and Wilcoxen (2009) examined border taxes that exactly offset carbon-cost increases of all EU manufacturing firms. They suggest that the impact of border carbon tariffs on overall import prices in the EU would be relatively small and that the border tax measures would therefore be little effective for EU import-competing industries in general. Takeda et al. (2012) evaluated the BTA policies as carbon regulations in Japan. Their results show that export border adjustments are effective for restoring the competitiveness of Japanese exporters and reducing carbon leakage. In addition, their analysis reveals that BTAs in Japan significantly affect carbon leakage to China on the one hand and the competitiveness of the iron & steel sector on the other. Böhringer et al. (2012b) carried out a survey on the role of BTAs in the unilateral climate policy under an Energy Modeling Forum Study (EMF-29). They find that border carbon adjustment can effectively reduce carbon leakage and ameliorate adverse impacts on the energy-intensive and trade-exposed (EITE) industries of unilaterally abating countries. However, the scope for global cost saving is small. The main effect of border carbon adjustment is to shift the economic burden of emission reduction to non-abating countries through the implicit changes in international prices.

On the other hand, there are few studies that have examined the feasibility of implementing an ECT policy in the developing countries, particularly in China. Wang et al. (2012) proposed that subjecting the energy-intensive sectors to a unique, stable and explicit carbon cost, introduced into the export value-added tax rebate at 20 US\$/t-$CO_2$, would be feasible for China, thus resolving both the competitiveness problem and the WTO concerns. Hűbler (2012) analyzed a contraction and convergence type climate regime, using a computable general equilibrium (CGE) model, which includes international capital mobility and technology diffusion. He suggests that if China does not participate in the regime and, instead, a carbon tariff is imposed on its exports, the welfare effects will likely be worse than in the case of participation. This study also casts doubt on the effectiveness of carbon tariffs as a direct instrument for reducing the leakage and emissions in general. Li et al. (2012) use a recursive dynamic CGE model based on China's 2002 input–output table, in order to investigate the economic rationale for directly taxing China's $CO_2$ emissions of exports. The results suggest that China's ECT has a slightly negative economic impact on its GDP, while the effect on its export structure is significant. The export of major energy-intensive products would decrease. In contrast, the export of labor-intensive and high value-added commodities would increase. The study of Li et al. focuses on examining the effects of different scenarios for redistribution of the ECT revenue. Nevertheless, it is worth pointing out that their analysis, perhaps due to the data constraint, does not take into account the terms-of-trade effects through the competitiveness channel in the international market. This is bound to result in underestimation of the negative impact on both gross domestic product (GDP) and export by EITE industries, the critical parameters in the feasibility study on ECT.

There is still lack of research on the feasibility and design of the ECT policy in China. Therefore, we elaborate on the existing studies, seeking to prove further evidence on the impact of different forms of BTAs. This paper uses a multi-region and multi-sector CGE model in order to derive a quantitative comparison of the economic and environmental impacts between BTAs levied by the abating coalition and ECT voluntarily implemented by China. We address the subsequent key policy questions:

1) How would the international competitiveness of China's EITE industries change under the carbon-based tariff policies?
2) To what extent could the domestic $CO_2$ emissions of China be reduced through carbon tariff approaches and, how effective are the relevant measures in restraining carbon leakage?
3) Compare the BTAs implemented by the abating countries with ECT conducted by China in order to find out which policy option is preferable for China.

The remainder of this paper is organized as follows. Section 2 describes the modeling framework and the data sources. In Section 3, we define the concepts of carbon permit price and border carbon adjustment tax. In Sections 4 and 5, we present the different policy scenarios for analysis and the results of our simulation, respectively. Finally, concluding remarks on policy implications are summarized in Section 6.

## 2. Model and data sources

### 2.1. Modeling framework

In this paper a modified version of the GTAP-EG model is used for the assessment. The GTAP-EG model is based on the GTAP8inGAMs package developed by Thomas Rutherford (2012), and documented for version 4.0 of the Global Trade Analysis project (GTAP) dataset and model in