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Does the current trade liberalization agenda contribute to greenhouse gas emission mitigation in agriculture?

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ABSTRACT

This paper contributes to the literature on the trade liberalization – climate change nexus by investigating the impact of the current free trade agenda of the European Union (EU) on the effectiveness of a possible greenhouse gas (GHG) reduction policy for its agricultural sector. For the analysis we implement scenarios with a carbon tax on non-CO_2 emissions and trade liberalization both individually and combined in CAPRI, a global partial equilibrium model for agriculture. Scenario results indicate that the simulated trade liberalization by itself has only modest effects on agricultural GHG emissions by 2030. Pricing agricultural non-CO_2 emissions in the EU triggers the adoption of mitigation technologies, which contributes to emission reductions. Emission leakage, however, partially offsets the EU emission savings as production increases in less emission-efficient regions in the world. The combination of agricultural trade liberalization and carbon pricing increases emission leakage and, therefore, further undermines global mitigation gains. Our results hinge on the key assumptions that future trade agreements between non-EU countries are not considered and that the climate actions are limited to the EU only. Despite these limitations we conclude that, from a global GHG mitigation perspective, trade agreements should address emission leakage, for instance by being conditional on participating nations adopting measures directed towards GHG mitigation.

1. Introduction

The Paris Agreement on Climate Change legally entered into force on 4 November 2016. Specific modalities and procedures still have to be negotiated, but in general the Paris Agreement requires all Parties to take on ambitious efforts to mitigate greenhouse gas (GHG) emissions and combat climate change through “nationally determined contributions” (NDCs). Enhanced international efforts to mitigate GHG emissions coincide with an increase in the number and scale of regional trade agreements. As the Doha Round of WTO negotiations stalls, large economies try to boost their economic growth by engaging in regional trade agreements with their main partners. Examples of such behavior include the Trans-Pacific Partnership (TPP) and the Transatlantic Trade and Investment Partnership (TTIP) negotiations, each covering a large share of global trade in goods and services. The EU follows a similar strategy and is increasingly engaged in regional trade negotiations (e.g. with Canada, USA or the Mercosur countries).

The parallel development of trade liberalization and GHG reduction policies raises the question on their interplay. Whether a continuous liberalization of the agri-food markets contributes positively or negatively to emission mitigation efforts is a complex empirical question. The theoretical framework of environmental effects of trade-liberalization (Grossman and Krueger, 1991) breaks down trade liberalization impacts on GHG emissions to the following three components: (1) the scale effect, i.e. liberalized trade boosts production and consumption, ceteris paribus increasing global GHG emissions; (2) the composition effect, i.e. facilitating trade also changes the composition of the goods produced and consumed, hence the net effect on global emissions depends on the emission intensity of the industries that gain from trade liberalization; and (3) the technique effect, i.e. liberalizing trade increases technological development and technology transfer, unequivocally leading to a reduction in global emissions by promoting more emission-efficient technologies. Whether the net environmental impact

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of these three effects is positive or negative requires a quantitative analysis that weights the individual effects. Existing empirical evidence is controversial regarding the relative weight of each of the effects. Overall results move between two extremes: (i) trade liberalization and globalization leads to environmental degradation, especially in developing countries, and (ii) more liberalized trade leads to increased economic growth with positive spill-over effects on the environment (Copeland and Taylor, 2004; Wiedmann et al., 2007; Peters and Hertwich, 2008; Huang et al., 2011; Peters et al., 2011). In any case, the mixed existing empirical evidence on the net aggregated effect of trade on global emissions hints towards the case specificity of impacts.

Against this background, this paper contributes to the debate by providing a detailed analysis on how trade liberalization agreements may affect global GHG mitigation efforts for a specific sector (agriculture) and a specific country-group (the EU) with a highly developed economic and policy environment. Accordingly, the main research question we pose is: How does trade liberalization impact the effectiveness of GHG policies in the EU agricultural sector? Addressing this question, we also discuss if, and to what extent, trade liberalization shifts EU emissions to trade partners and other third countries or vice versa, and what the net impact on global emissions is. More specifically, we investigate this issue focusing on the impact of the agricultural provisions of the regional Free Trade Agreements (FTA) currently under negotiation between the EU and 3rd parties (Boulanger et al., 2016), and a (still hypothetical) policy aiming at reducing (non-CO_2) GHG emissions in EU agriculture enforced by means of a carbon tax[1] (Pérez Domínguez et al., 2016).

The choice of the agricultural sector as the focus of our interest is motivated by its importance in non-CO_2 (methane and nitrous oxide) GHG emissions, and by its important role in global food security. As key results we present production and GHG emission effects in the EU and globally, quantifying also emission leakage of trade liberalization when implemented in isolation or combined with climate policy. More specifically, we compare three scenarios against a business as usual reference for 2030. First we show how trade liberalization alone affects production and emissions, second we show how production and emissions are affected by a unilateral carbon tax for non-CO_2 emissions of EU agriculture, and last we show how the combination of the two adds up.

2. Methodology

For the analysis, we use the CAPRI (Common Agricultural Policy Regional Impact Analysis) modelling system (Britz and Witzke, 2014). CAPRI is a large-scale, comparative static, partial equilibrium model focusing on agriculture and the primary processing sectors. CAPRI links a set of mathematical programming models of the EU regional agricultural supply to a global market model for agricultural commodities. The regional supply models follow a Positive Mathematical Programming (PMP) approach for simulating the profit maximizing behavior of representative farms for all EU regions. The regional supply models are linked with a sequential calibration approach to a global multi-commodity model of the agricultural markets. International trade in the market model is implemented following the Armington assumption (Armington, 1969), i.e. imported goods are differentiated by place of origin, and consumer preferences for import demand are calibrated to a benchmark dataset (Britz and Witzke, 2014).

The standard market module in CAPRI also includes explicit Tariff Rate Quota (TRQ) functions. In this paper, however, the TRQ functions are converted into ad-valorem equivalent (AVE) tariff rates in order to simplify the scenario assumption. Representing the TRQs with their AVE equivalent tariff rates enables us to simply cut them by a given percentage, without going into assumptions on possible quota expansions or changes in in-quota or out-of-quota tariff rates. The drawback of the AVE representation of TRQs is that it might magnify trade liberalization impacts, as reaching the quota threshold does not anymore imply an immediate increase in tariff rates in the model (Himics and Britz, 2016).

With regard to GHG accounting, CAPRI endogenously calculates EU agricultural GHG emissions for nitrous oxide and methane based on the inputs and outputs of production activities. Following the IPCC guidelines (IPCC, 2006), a Tier 2 approach is used for the calculation of activity-based emission factors, but where the respective information is missing a Tier 1 approach is applied (e.g. rice cultivation). Several specific technological (i.e. technical and management-based) GHG mitigation options for EU agriculture are considered, focusing on technological options that are already available or will likely be available at the simulation year 2030. Some of them are already used in EU agriculture (e.g. precision farming) but there is ample room for expansion to a much larger number of farms or production activities. The 14 mitigation technological options listed in Table 1 have been specifically considered for this paper and can be applied by EU farmers (for a detailed description of each technology see Pérez Domínguez et al. (2016).

The underlying assumptions on implementation costs, cost savings, mitigation potential of the modelled technological mitigation options are mainly taken from the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) database (GAINS, 2013, 2015; Höglund-Isaksson et al., 2013, 2016), and information collected within the AnimalChange project (Mottet et al., 2015). The level of production activities and the use of mitigation technologies are constrained by various factors, including land availability, fertilization requirements of the cropping systems versus organic nutrient availability, feed requirements in terms of dry matter, net energy, protein, and fiber for each animal. Moreover, production activities and decision making are also influenced by agricultural and environmental policy restrictions. A detailed description of the general calculation of agricultural emission inventories in CAPRI is given in Pérez Domínguez (2006), Leip et al. (2010) and Pérez Domínguez et al. (2012), and detailed description of the modelling approach related to the technological GHG mitigation options is presented in Van Doorslaer et al. (2015), Pérez Domínguez et al. (2016) and Fellmann et al. (2018).

Two additional issues are worth mentioning. First, the calculation of emissions is not homogenous between the EU and the rest of the world. While the emissions of EU agriculture are calculated directly based on the IPCC guidelines on a per activity basis in the CAPRI supply model, GHG emissions for the rest of the world are estimated on a commodity basis (i.e. per kg of product) in the market model of CAPRI. Second, and linked to the different calculation approach, in previous analyses non-EU emission intensities were purely based on historic emission and production data from FAOSTAT. This did not allow the integration of technical trends, e.g. improved emission efficiency over time. As the projection year for our analysis is 2030, neglecting trends in emission intensities in non-EU countries could lead to an overestimation of emission leakage (Barreiro-Hurle et al., 2016). GHG emission intensity improvements in the rest of the world could be a result of climate or non-climate related developments. Improvements could, for example, come of developed countries allocating climate funding to the adoption of GHG mitigation technology or as a consequence of GHG mitigation policies being implemented and subsidized in non-EU regions. Additionally, emission mitigation may also spread irrespectively of climate change concerns, for example if fertilizer efficiency improves or if anaerobic digestion plants are installed for purely economic reasons. Global emission trends could also imply a deterioration of efficiency over time due to composition effects.[2] To incorporate the possibility of emission intensity changes over time, trend functions are estimated for the emission intensities in the rest of the world using IPCC Tier 1 coefficients as prior information within a robust Bayesian estimation framework, combining data on

[1] A carbon tax refers to a tax attributed to a unit of emissions expressed in CO_2 equivalents.

[2] Assume, for example, that production of beef in one country is represented by a single value, but in reality production takes place both in dairy systems in one part of the country and with dedicated beef breeds in another. If the relative weights of those systems in overall beef production would change, the average emission intensity of "beef" would change too.