Land use change: could trade liberalization make biofuels work?

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Abstract **– According to the European directive on renewable energy, biofuel consumption should reach 10% of total transport fuel consumption in the European Union (EU) by 2020 to help reducing greenhouse gas (GHG) emissions. Biofuels provide new income opportunities for farmers but also increase the competition for land between different uses. The potential negative impact of biofuel expansion on environment and food security is a main concern. Ethanol and biodiesel imports amount to 19% and 15% of EU total consumption and most of biofuels produced in the EU used domestic feedstock. We analyze impacts of European biofuels trade policies on emissions from land use changes and on food commodity markets until 2020.**

INTRODUCTION

Evolution of biofuel production has been spectacular since 2000, mainly driven by national policies. From an environmental point of view, the initial expectations that biofuels will help to reduce greenhouse gases (GHG) emissions compared to conventional fossil fuels are being increasingly questioned (Searchinger et al., 2008; Havlik et al., 2010). Second generation biofuels should reduce pressures on land in improving the energy conversion of woody biomass and in extending the source of usable biomass as a feedstock. But, there is little chance that large-scale second generation biofuel production will be commercially viable before 2020. The European biofuel consumption target of 10% of total transport fuel consumption will thus need to be achieved through first generation biofuels using crops as primary feedstock. But diversion of crops from food and feed to fuels in a more and more populated world also raises concerns about the impacts on food commodity markets.

The European Union is a major actor on global agricultural markets and hence European trade policies impact other world regions. Currently, the EU applies tariffs on ethanol imports, and the fuel quality standards also provide a strong element of border protection for biodiesel. On the one hand, trade liberalization is likely to increase biofuel imports to the EU which will induce GHG emissions from land use change (LUC) in those regions where the biofuel feedstocks are produced (direct trade effects). On the other hand, without trade liberalization, the diversion of locally produced crops from food to energy in the EU may affect global agricultural markets and also necessitate land use changes in other regions (indirect trade effects). The optimal trade policy with respect to climate change mitigation will largely depend on which of the two trade effects is stronger. We expect that trade liberalization will help mitigating the surge in food prices in using the most efficient feedstock to produce biofuels and in allocating this production to regions with comparatively lower competition for land.

Our analysis departs from CGE aggregated approaches (e.g. Hertel et al., 2008) in using a physically-grounded bottom-up model. We show that liberalization of trade in biofuels by the EU would be beneficial from the climate change mitigation perspective. The effects on world food prices are small on average.

METHODOLOGY

For this study, we use GLOBIOM, a partial equilibrium model covering the main land-based sectors i.e. agriculture, forestry and bioenergy. Prices and quantities are endogenously computed according to supply and demand functions considering resource endowments, technological, and policy constraints for 28 regions globally. The supply side of the model is structured with high spatial resolution. Crop and forest productivities and site and management specific environmental impacts have been simulated by means of bio-physical process models (e.g. EPIC, G4M) on grid sizes between 10x10 to 50x50 km depending on the heterogeneity of the biophysical conditions. The model directly represents production from cropland, managed forest, and areas suitable for short rotation tree plantations based on Leontief production functions.

18 crops representing more than 75% of the global cropland are included. Soybean, oil palm, and rapeseed can be further processed to produce biodiesel while sugarcane, corn, and wheat can be used to produce ethanol. The by-products of biofuels produced from rapeseed, soybeans, or wheat are used for livestock feeding.

Since GLOBIOM is written as a spatial equilibrium model, bilateral trade flows are part of the model solution according to the minimization of trade costs. Tariffs on biofuels are taken from OECD while tariffs for the other products come from the MacMap database. A common pitfall of empirical models is the discrepancy between observed trade flows and the

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trade flows generated by the model solution. An original procedure based on the work of Jansson and Heckelei (2009) is used to calibrate in a consistent way trade flows, transportation costs, and prices for a reference year.

Projections of fuel consumption by 2020 in the EU come from the World Economic Outlook (WEO) 2008. We make the assumption that the biofuel consumption target will be split between biodiesel and bioethanol in the same proportion as diesel and gasoline on total fuel consumption i.e. around 70% to 30%.

The future of biofuel trade is still under debate in the EU, with divergent points of view among member states. The reference scenario corresponds to a situation where trade policies remain the same as today. Then, we implement two other scenarios which correspond to two extreme cases regarding trade policies: *i)* a scenario where we assume that prohibitive trade barriers prevent biofuel imports in the EU, and *ii)* a scenario where import tariffs on biofuels are completely removed.

Results

Our model results show that without any biodiesel imports in 2020, Europe will process 1.6 times more rapeseed than is needed when current trade policies are maintained, and 4 times more with free trade in biofuels. Restrictions in trade in biofuels force to increase the area allocated for rapeseed production in Europe, mostly at the expense of cereals. This has major consequences on European exports of barley, corn and wheat, and consequently on markets in Sub-Saharan Africa, and North Africa which are the main destination of European cereal exports. This decrease in imports is, especially in Sub-Saharan Africa, compensated by the expansion of local production. The resulting increase in food self-reliance in those regions could improve food security especially in rural areas. However, the expansion of cropland is at the expense of forested areas leading to additional GHG emissions.

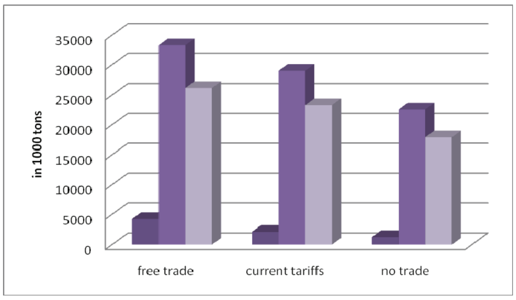

Figure 1. European exports of cereals in relation to biofuel trade policies

The global emissions from deforestation when the EU imports no biofuels at all are 5% higher than in the free trade situation. It is because the EU imports a large share of biodiesel based on rapeseed and soybean from regions where no deforestation occurs as Canada, Turkey or the USA. The EU also imports all bioethanol from Brazil when trade is fully liberalized which leads to some deforestation. However, emissions related to direct trade effects in Brazil are smaller than emissions related to indirect trade effects in the food importing regions as Sub-Saharan Africa.

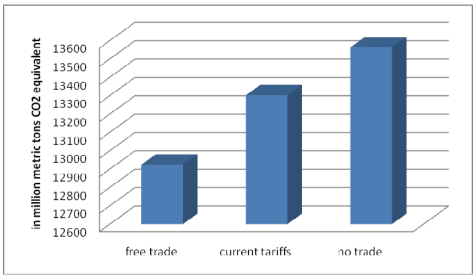

Figure 2. Total GHG emissions from deforestation according to different European biofuel trade policies in 2020

As expected, trade liberalization decreases the pressure on food markets, but the impact is the largest inside the EU. In the other regions, there is only a slight decrease of crop prices after liberalization.

Conclusion

Modelling results are in general sensitive to many assumptions. For example, our assumption that 70% of biofuels consumption will come from biodiesel is questionable. There is also still some uncertainty about the share of biofuel by-products which can be economically used by the livestock sector. These parameters influence the profitability of the different biofuel pathways. However, our sensitivity analysis on these two parameters confirms the main results and therefore their robustness about the GHG mitigation effects of the EU biofuel trade liberalization in 2020.

Biofuel markets are distorted through other than trade policies as well. For instance, Elobeid and Tokgoz (2008) have shown that the impact of the removal of the tax credit overrides the impact of the tariff removal in the US. This will be our next research focus.

Literatur

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