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BIOFUELS TARGETS AND MANDATES AROUND THE WORLD: IMPACTS ON ENERGY AND AGRICULTURAL MARKETS

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Abstract

The production of biofuels is considered to be a promising energy source for a sustainable energy mix and it is politically promoted in many countries. While many studies focus on the impacts of biofuels on direct and indirect land use change as well as the resulting greenhouse gas emissions and food prices, the effects on energy markets have mostly been neglected. Furthermore, most studies concentrate on the European and US biofuel mandates, ignoring the impacts of biofuel mandates in other countries around the world, such as those in Brazil, Argentina and India, which definitively influence the global demand and supply of biofuels. Therefore, this paper aims to analyse price changes in agricultural and energy sectors under a gradual and simultaneous implementation of national biofuel targets. Biofuel production is not only driven by government mandates, high oil prices or efforts to mitigate climate change but also by the availability and competition for arable land, which is highly influenced by demographic pressure. To capture the complex interactions between these global economic drivers, we use the new version of the Dynamic Applied Regional Trade (DART) model, which is a recursive dynamic computable general equilibrium (CGE) model capable to analyse the economy-wide impacts of land use changes on a global scale. The results highlight the central role of key parameters to be considered when modelling land use and first generation biofuels and their impact on agricultural and energy markets. The results suggest that a partial analysis of national biofuel targets and mandates lead to different outcomes and may underestimate the worldwide impact of biofuel policies. Land use changes and substitution of fossil energy sources with biofuels induced by national biofuel quotas have significant direct and indirect effects across sectors and countries. Domestic and world food and energy markets react inducing changes in regional welfare.

Keywords: Computable General Equilibrium, Agriculture, Bioenergy Policies

JEL Classification: D58, Q17, Q58

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1. Introduction

The production of biofuels is considered to be a promising energy source for a sustainable energy mix. It is expected that they contribute to the mitigation of greenhouse gas emissions by substituting fossil energy sources, that they contribute to energy security by diversifying energy supply, and that they support rural areas and farmers by generating additional source of income. For these different reasons, several countries have started bioenergy programmes to promote the production of bioenergy.

The largest biofuel programmes have been launched by Brazil, the United States of America (USA) and the European Union (EU). In the case of bioethanol, Brazil and the USA started their ethanol programs in the late 1970s. Until 2006, Brazil was the global leader in bioethanol production (F.O. Licht 2005, p. 430). However, due to political incentives such as the US Energy Independence and Security Act (United States Cong. Senate, 2007) and the Renewable Fuel Standard, which calls for the use of 7.5 billion gallons of biofuel by 2012 the US ethanol production currently exceeds that in Brazil.

In the European Union, the EU's directive on the use of energy from renewable sources (European Union 2009) demands a share of renewable energy sources (including non-liquids) of 10% in total transport fuel use by 2020. The directive allows for substitution with other renewable sources such as electric cars. Another important feature is that second generation biofuels will be counted twice toward EU mitigation targets (European Union 2009).

While many studies focus on the impacts of biofuels on direct and indirect land use change as well as the resulting greenhouse gas emissions and food prices, the effects on energy markets have mostly been neglected.

Furthermore, most studies concentrate on the European and US biofuel mandates. Impacts on food price, land use change and associated greenhouse gas emissions of the European or US American biofuel policies have been investigated in various studies (for EU biofuel policies see e.g. Banse et al. (2008), Kretschmer et al. (2009), Al-Riffai et al. (2010) and Laborde (2011); for the US biofuel policies see Hertel et al. (2010a)). The combined effect of the US and EU biofuel policies have been analysed by Valin et al. (2009) and Hertel et al. (2011) disregarding the impacts of biofuel mandates in other countries around the world, such as those in Brazil, Argentina and India, which influence the global demand and supply of biofuels.

Therefore, this paper aims to analyse price changes in agricultural and energy sectors under a gradual and simultaneous implementation of national biofuel targets. The analysis is based on a new version of the DART model, a global computable general equilibrium (CGE)

model that allows for a rich set of economic feedbacks and for a complete assessment of the welfare implications of alternative development pathways. The task of modelling land use interactions in the new version of the DART model gives rise to a number of methodological challenges: first, land is a heterogeneous production factor, and its possible uses are restricted according to agro-ecological zones. Second, first generation biofuels and its by-products are modelled based on data from 2007, which allows to capture recent dynamics and developments in biofuel markets.

The remainder of the paper is organized as follows: the next section gives a worldwide overview of biofuel markets and policies. Section 3 describes the new features of the DART model giving a special emphasis on data construction and requirements. In section 4, the economywide impacts of global biofuels policies are analysed based on 4 different scenarios. Section 5 contains discussion and conclusions.