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Impact of increasing liquid biofuel usage on EU and UK agriculture

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ABSTRACT

The biofuels industry in both the UK and the EU as a whole has expanded significantly in recent years in response to various EU biofuel policy initiatives. Further expansion of biofuel demand will increase the impact of the biofuels sector on agricultural markets. This paper examines the impact that increasing levels of first generation biofuel demand to 10% of total transport fuel use in the UK and other EU Member States would have on agricultural markets within the EU and specifically the UK using a partial equilibrium modelling system. Increasing overall biodiesel demand raises demand for vegetable oil and oilseed and in turn their prices. The increased grain demand in response to the increased bioethanol demand is mostly sourced from changes in EU net trade.

Introduction

The biofuels industry in the European Union (EU) has expanded rapidly in recent years. The industry operates in a complex policy environment, with policies at the national and EU level impacting both production and consumption. The EU Biofuels Directive (European Commission, 2003), for example, encouraged member states to increase use of biofuels and other renewable fuels in transport to 5.75% (calculated on the basis of energy content) by 2010. In response to the 2003 Biofuels Directive, the UK government introduced the Renewable Transport Fuel Obligation (RTFO) Order (Office of Public Sector Information, 2007) which requires fossil fuel suppliers to increase the supply of biofuel to 5% (calculated on the basis of volume) in the total road transport fuel they supplied by 2010.

Despite being viewed as a solution to the problems of climate change, energy security and as a new measure for rural development and farm income support, some commentators have expressed concerns about the impact of increased biofuel production on global food prices (e.g. Mitchell, 2008) and the environment through for example deforestation (e.g. Fargione et al., 2008; Searchinger et al., 2008; The Gallagher Review (Renewable Fuels Agency, 2008)). In light of these growing concerns, the UK government has effectively slowed down the targets for increased biofuel supply; i.e., requiring fossil fuel suppliers to supply 5% (volume basis) of biofuels in the total road transport fuel supply by 2013/2014 rather than by 2010/2011 (Office of Public Sector Information, 2009). On the other hand, the EU has extended its commitment to biofuels use by requiring a minimum target of 10% (energy content basis) renewable fuels in transport by 2020, conditional on the sustainability of the fuels (Renewable Energy Directive (RED) (European Commission, 2009)).

The expansion of biofuels production as a result of these policies will increase the impact of the biofuels sector on agricultural markets and this therefore necessitates its incorporation into agricultural market modelling frameworks. This paper describes the incorporation of a liquid biofuels model within the Food and Agricultural Policy Research Institute-UK (FAPRI-UK) modelling system, where a regional model of the UK is simulated simultaneously with an EU component. Scenario results are presented in order to examine the likely impact of the increasing biofuels usage in road transport on the liquid biofuels and agricultural sectors in the UK and the EU as a whole.

The paper is organised as follows: in Section ‘Recent studies on the impacts of biofuels’ recent empirical studies of the impacts of biofuels on agricultural markets and the environment, especially in the EU, are reviewed; in Section ‘Methodology’ the methodology underlying the analysis is discussed; this is followed by a description of the Baseline projections and the scenario in Section ‘Baseline projections and scenario analysis’; the impacts of the

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scenario on the biofuels sector and agriculture sectors in the EU and UK are analysed in Section 'Results'; and finally, some conclusions are drawn in Section 'Conclusions'.

Recent studies on the impacts of biofuels

Biofuels have been the focus of much debate in the agricultural economics literature over the past decade as the industry has expanded significantly, which has given rise to important implications for agricultural markets, land use and environment. This attention has increased following the recent (2007/2008) agricultural commodity price spikes. A large number of studies (e.g. Abbott et al., 2009; Baffes and Haniotis, 2010; Gilbert, 2010; Headey and Fan, 2008; Mitchell, 2008; Piesse and Thirtle, 2009; Westhoff, 2010) have analysed the causes of rising food prices and assessed their role quantitatively and qualitatively.

While many factors such as the weather, energy prices, government policy (e.g. export bans), economic growth and changing diets in emerging economies, the depreciation of the United States (US) dollar and speculation are believed to have contributed to the 2007/2008 food price increases, many studies have also identified biofuels as one of the significant factors. However, there are large variations in the magnitude of the impact of the biofuels sector. On one hand, Mitchell (2008) attributed the majority (70–75%) of food commodity price increases over January 2002–June 2008 to the large increase in biofuels production in the US and the EU. He argued that biofuels policies subsidised biofuels production in the US and the EU thus should be reconsidered in light of biofuels' impact on food prices. On the other hand, Gilbert (2010) argued that biofuels, even with other residual factors, were only responsible for at most one-quarter to one-third of the food price rise in 2006–2008.

The impact of biofuels is not limited to food prices, but extends to land use and in turn Green House Gas (GHG) emissions and biodiversity associated with Land Use Change (LUC) including Indirect Land Use Change (ILUC). The rising agricultural commodity prices due to the increasing demand for biofuels not only reallocate land use for these agricultural feedstocks, depending on the relative price changes but also increase aggregate land use in crop production as the competition for existing agricultural land intensifies (Fabiosa et al., 2010).

Fabiosa et al. (2010) compared land allocation effects for important crops and countries from the changes in the United States (US) and global (i.e. Brazil, China, the EU and India) ethanol demand using the global FAPRI model. They found that the global ethanol expansion, mainly from Brazilian sugarcane, has fewer effects on existing arable land allocation than does the US ethanol increase from maize. This finding is explained by the fact that maize competes with more crops for land than sugarcane.

In addition to the impact of biofuels on food prices the development of the biofuel sector has important implications on the transmission of price volatility from energy markets to agricultural markets. The expansion of the biofuel sector has potentially strengthened the linkages between the oil and agricultural markets since biofuels are substitutes for oil in the transport energy market. Westhoff (2010) illustrated this interrelationship coupled with biofuel policies using the oil, biofuels and agricultural commodities data from 2005 to 2009.

As discussed above, the issues regarding biofuels are complicated and global and therefore impact analyses require large scale agricultural policy models. Many existing Partial Equilibrium (PE) agricultural sector models and Computable General Equilibrium (CGE) models have been modified to incorporate the biofuels sector. While many of these models have analysed the overall impact of world and/or US biofuels, some studies (e.g. European Commission, 2007; Banse et al., 2008; Gohin, 2008) have exclusively focused on the impacts of EU biofuel policies. In addition, the European Commission authorised various PE or CGE based studies analysing the impacts of EU biofuel policies on agricultural markets, ILUC and GHG emissions since 2009; these were in the context of RED that requires the Commission to submit a report on the impacts of ILUC of biofuels to the European Parliament and to the Council by 31 December 2010.

As part of the Commission's research on biofuels, Al-Riffai et al. (2010) analysed the impacts of the EU biofuels mandate using a modified version of the MIRAGE global CGE model with the extension of the GTAP database. The results indicated that the food bundle price increases only slightly (i.e. 0.5% in Brazil and 0.14% in Europe). In addition, world cropland increased by 0.07per cent. Finally, it saved 18.17 million tonnes (Mt) CO_2 in terms of direct emissions but produced 5.33 Mt CO_2 associated with the ILUC which resulted in a global net balance of 13 Mt CO_2 savings annually over a 20 year horizon. However, the study also indicated that the ILUC can rapidly increase as the EU biofuels share rises above the 5.6% scenario level.

Edwards et al. (2010) compared six different models (i.e. AGLINK-COSIMO from OECD, CARD from FAPRI-ISU, IMPACT from IFPRI, GTAP from Purdue University, LEITAP from LEI and CAPRI from LEI) land use change results for a marginal change in particular biofuels demand (1 million tonnes of oil equivalent ethanol or biodiesel increase) in particular regions (EU or US) as part of the Commission's effort to examine biofuels impacts. In general, the results showed that the larger share of LUC occurred outside the EU (or the US) as the biofuel demand increase in the EU (or the US).

Three different PE agricultural modelling systems were also commissioned by DG AGRI to assess the EU biofuels policy impacts. Fonseca et al. (2010) compared these models (i.e. AGLINK-COSIMO, ESIM and CAPRI) and documented their results on the EU biofuels policy impact analysis. Although it is difficult to directly compare results of these models, some general conclusions on the effects of EU biofuel policies can be drawn:

- Domestic production of both bioethanol and biodiesel is significantly higher in all models as a result of the policies except the relatively mild increase in biodiesel in the ESIM (22%).
- Markets for biodiesel and its feedstocks are generally affected to a much greater extent than those of bioethanol and its feedstocks.
- Feedstock yield and total EU agricultural land use responses to price changes are limited.
- Knock-on impacts on EU livestock industries is negligible.

Methodology

The model is based on the incorporation of a liquid biofuels model (i.e. biodiesel and bioethanol) within a partial equilibrium commodity modelling system. The model's focus is the interaction of the agriculture sector and the production of first generation biofuels. In reality the biofuels issue lies within a much broader relationship between agriculture and energy sectors (Woods et al., 2010). The development of new, second generation fuels, some of which will be based on agricultural feedstocks, will add complexities to these linkages. The paper presented here is, however, deliberately focused on the issue of changing levels of first generation fuels, and interactions between biofuels, energy and agriculture.

The model covers the EU-27, with some regional disaggregation, including the UK. The UK component captures the dynamic interrelationships among variables influencing supply and demand of the major agricultural commodities in England, Wales, Scotland and Northern Ireland (see Moss et al., 2010). The EU liquid biofuels model, in conjunction with the UK liquid biofuels model,