Spatial Pricing Patterns of Cellulosic Biomass under Oligopsony – A Multi-agent Simulation Model

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The US Renewable Fuels Standard (RFS) and Renewable Portfolio Standard have created enormous demand for cellulosic biomass, such as agricultural residues and energy crops, to produce ethanol and electricity respectively (EERE, 2011; EPA, 2011). To meet the biomass demand for fuel production purposes, the firms will have to develop biomass collection areas or 'harvest sheds.' There will be competition for cellulosic biomass if more than one firm locates within the same collection area. The competition can drive up biomass prices. The prices for biomass depend on the proximity of other biomass processing units, extent of overlap, type of output fuel outputs (electricity or liquid biofuel) and the corresponding fossil fuel prices. There could be fierce competition for cellulosic biomass resulting in higher biomass prices.

This paper uses an oligopsony framework to study the competition among the fewer firms that compete for cellulosic biomass within a region (Mead, 1966). The oligopsony model analyzes (i) collusive pricing where the competing firms (tacitly or explicitly) collude in setting prices for cellulosic biomass, and (ii) non-collusive pricing where fewer firms compete fiercely for biomass by bidding up biomass prices (*ibid*). The possibility and extent of collusion depends on multiple factors such as fossil energy prices (crude oil, coal, and natural gas), the suitability of biomass to produce one or more forms of bioenergy along with spatial and temporal restrictions on biomass availability. Both these cases are compared with the reference case where the firm has monopsony power in biomass procurement.

Such strategic interactions among fewer firms are studied with a multiagent simulation model (Wilensky, 1999). It simulates the demand for cellulosic biomass and determines the prices endogenously depending upon competition. A simulation model is chosen in this analysis, as opposed to an econometric estimation, due to lack of data to model cellulosic biomass markets. The cellulosic biomass pricing is modeled as a game between two firms that buy biomass to produce either same or different outputs (electricity and ethanol). Netlogo software is used to model the interactions within the harvest shed. An advantage of this software is its graphic user interface that makes the results easily understandable and intuitive (Wilensky, 1999).

The results will cover the following: the spatial and temporal pattern of prices when the harvest sheds overlap (oligopsony) versus the case where the harvest sheds do not overlap (monopsony); the impact of fossil fuel prices on biomass prices; and how the biomass quality variables affect cellulosic biomass pricing under oligopsony. The preliminary results suggest that competition plays a key role in developing harvest sheds; the extent of harvest shed overlap is a key factor as well. Future extensions of the proposed model include comparisons of single vs. multiple feedstocks, perennial vs. annual feedstocks, evaluation of geographic spread of bioenergy firms within a state or region.

Supporting statement:

The market power and implications of oligopsony market structure have been analyzed for various food industries such as beef industry, retail food marketing and paper industry (Cai, et al., 2009; Ji and Chung, 2010). While these markets have econometric data, the cellulosic biomass industry does not have such data. Hence, a simulation model using a multiagent modeling framework would be useful. This paper uses a novel modeling platform called Netlogo to model market interactions. The emphasis of this poster will be to identify the 'patterns' of results (rather than the results themselves) in line with complexity analysis (Santa Fe Institute, 2011). This analysis can provide useful pieces of information in designing and developing cellulosic biomass harvest sheds in the emerging bioenergy sector.

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