The Role of Vertical Integration, Risk and Uncertainty in Biomass Supply

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Introduction

Future growth in biofuel production is likely to come from alternative 'advanced' biofuel feedstock pathways, including dedicated energy crops and high-sugar feedstocks. Feedstocks, such as sugar, sugarcane, energy beets and sweet sorghum, are expected to fulfill some of the advanced biofuels requirements to meet renewable fuel standard (RFS2) mandates. However, the conversion of these feedstocks into biofuels and their commercial viability are mainly dependent on investment and feedstock costs, technical efficiency, the price of ethanol, market structure, and logistics for the production, harvest, storage, and delivery of these sugar feedstocks. Few studies have analyzed the technical feasibility and profitability of the energy beet to ethanol pathway in the U.S. There is little research investigating energy beet market organization issues, such as transaction costs, organizational decisions and producer willingness to grow and supply feedstock under contracts in a vertically-integrated biomass supply chain. Thus far, markets for energy beet biomass are not yet developed, implying that there remains much uncertainty at all stages of the supply chain both for farmers and biorefiners. Although technical feasibility studies provide information about the viability of energy beet ethanol, such studies do not necessarily provide information about farmer's willingness to engage in energy beet production and supply. In the absence of spot markets for energy beets, potential beet ethanol refineries need to rely on long-term contracts to convince farmers to produce and deliver energy beet feedstock over time. Conversely, farmers will not adopt and sign long term contracts unless the payoff from producing the energy beet is at least as high as the payoff from the next best use of the land. In the absence of established markets and risk management mechanisms, well-designed contracts, with price and production incentives, may encourage farmers to engage in the production and supply of energy beet biomass.[1, 2]

The objective of this study is to investigate the impact of net return variability and farmer risk perceptions and characteristics on willingness to supply energy beet biomass to potential biorefineries. Specifically, the study will analyze how changes in net returns influence the proportion of acreage farmers are willing to commit to grow energy beets given contract attributes, farmer specific risk perception factors, their production technology and short-run fixed input constraints.

Research Methodology

If a farmer chooses to grow and supply energy beets under a specified net return and contract term, then it is assumed that the subjective expected utility from producing energy beets under that specified contract exceeds that of producing energy beets under alternatively-specified contracts, as well as the next-best traditional crop alternative. Empirically, the willingness to supply energy beets can be derived from a random utility model [3, 4, 5] assuming that the objective of the producer is to maximize subjective expected discounted utility, over time, when choosing to commit acreage to grow and supply beets, given the net return offered under menus of contracts, their production technology and short-run fixed input constraints. Thus, the willingness to supply is expressed as a function of net returns, contract attributes, a vector of farmers' individual risk perception factors and other characteristics, technological factors that affect production and other exogenous factors that affect decision-making. For the regression model, an iterated principal factors (IPF) model will be used to condense risk perception factors into three latent class factors. Econometrically, the percentage of acreage supply of the farmers will be estimated as a truncated regression model using a simulated maximum likelihood estimation procedure.[6]

Data

A stated choice experimental survey was employed to elicit North Dakota agricultural producers' willingness-to-grow and supply energy beets. A three-phase survey technique was administered to encourage survey participation: initially administered in person as a paper version, then the paper version was converted to an online format using Qualtrics software, and finally a mail survey was conducted in late December 2015. The content and procedures of the survey were similar in all three methods. The survey has four distinct sections requiring farmer input. The first section collects farmer demographics and information about their farm enterprise, followed by a section that elicits attitudes, including perceptions of risk, willingness to adopt new technologies and crops, and general attitudes about contracts, capital investment, insurance, labor and the environment. The third section of the survey is specifically geared toward investigating farmer preferences between different types of contract design mechanisms. The final section of the survey uses a stated choice approach to attempt to elicit energy beet willingness-to-supply by asking farmers to make a production commitment based on contract attributes. In the final section of the survey, which is the focus of this study, farmers were asked to commit a percentage of their land for a given net return considering contract length, a contract pricing mechanism, a quantity accepted mechanism and a harvest method. Contract pricing mechanism are: 1) Fixed; 2) Formula (10x Chicago Corn); 3) Formula with a Floor; and 4) Formula with a Ceiling. Quantity accepted mechanism are: 1) All Production; 2) All Production Minimum required; 3) Capped No Additional; 4) Capped Negotiated Price.

Anticipated Results, Conclusions and Implications of Findings

This paper is based on an ongoing research project and in the early stages of data compilation and model specification. We predict that willingness to supply will be elastic with respect to the net return considered. We anticipate that optimal supply schedule will be obtained under a contract that comprises the highest net returns, formula with a floor pricing, accepts all production, with third party harvest, as these contract attributes pass-along yield and price risk to the biorefinery. A fixed price contract for a given quantity of biomass delivery may exposes farmers to energy crop yield risk while a formula with a floor contract exposes the biorefinery to both yield and price risk. The optimal contract may involve a contract that ensures risk sharing between the farmers and the biorefinery that minimizes their joint risk premia. [1] To this end, we anticipate that the supply schedule will depend on the interaction between farmers' risk preferences and the risk-return tradeoff of growing energy beet crops relative to existing uses of that land.

The results of this study identifies how biomass production in a region can be vertically integrated with biofuel industries by illustrating factors that affect farmers' decision making. Investigating energy beet market organization, farmers' willingness to supply with respect to contract attributes and farmers' risk preferences is crucial to identify potential barriers to adoption of energy beet biomass and create an efficient biomass supply chain that can help to procure biomass in a cost effective manner to support the development of advanced biofuel industries.

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