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# IMPACT OF A CORN STOVER MARKET ON CORN AND SOYBEAN PRODUCTION: EMPIRICAL ESTIMATION

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| **Soybean to corn price ratio** | **2.3** | **2.2** | **2.1** | **2.0** | **1.9** |
|---|---|---|---|---|---|
| Stover price $10/ton | | | | | |
| Corn production, million bu | 1,791 | 2,149 | 2,732 | 3,037 | 3,156 |
| Soybean production, million bu | 524 | 407 | 217 | 118 | 79 |
| Stover price $100/ton | | | | | |
| Corn production, million bu | 2,679 | 2,679 | 2,732 | 3,037 | 3,156 |
| Soybean production, million bu | 234 | 234 | 217 | 118 | 79 |

**Table 1** Production of corn and soybeans under alternative corn stover prices

## RESEARCH QUESTION

Advancements in cellulosic ethanol production technologies are expected to lead to the establishment of viable markets for corn residues (stover), which are comprised of corn stalks, cobs, and leaves left in the field after grain harvest. Recent research has focused on estimation of the amount of stover that could be brought to market (English et al., 2005). Given that corn stover is in essence a by-product of corn production, a large, viable market for stover will alter the profitability of corn relative to other traditional row crops and may affect significantly the supplies of both corn and other crops. Empirical estimates of the stover market impact on the production and acreage under traditional row crops are scarce. On one hand, Taheripour and Tyner (2008) hypothesize a small impact of a corn stover market on land use change. On another hand, Kurkalova et al. (2010) estimate a sizeable effect of high corn stover prices on the cropping patterns in Iowa. We quantify empirically the shifts in corn and soybean production possibilities frontier under alternative corn stover prices.

## METHODOLOGY

The study uses the economic modeling systems operating on field-level, GIS-based cropping history and soils data developed for the state of Iowa (Kurkalova et al., 2010). In the model, rotation and tillage choices are simulated on 56 meter square grid covering all the Iowa land that has been cropped in 2009. The grid comes from the U.S. Department of Agriculture National Agricultural Statistical Service GIS-based remote-sensing crop-cover maps.

For each grid unit, we use the measures of soil productivity that come from the Iowa Soil Properties and Interpretations Database GIS soil data layer. Soil productivity is measured by the Corn Suitability Rating (CSR), an index from 0 to 100 with the higher CSR values corresponding to the higher land's productivity in corn production. We assume that production exhibits constant returns to land of any given quality, and simulate the field-by-field farmers' choices by comparing multiple-year cumulative expected net returns.

The expected net returns are the difference between expected revenue and the expected costs of production. The expected revenue is the product of crop price and expected yield, plus the revenues from selling corn stover if a famer decides to participate in the corn stover market. Following previous research, maximum possible stover production is estimated to be equal to corn grain mass produced. We also assume that farmers chose between two alternatives concerning stover harvesting only: to collect 50% of available residue, or do not harvest any stover. In estimation of the costs of production, we follow the crop production budgets developed by Iowa State Extension (Duffy, 2009; Edwards, 2007). We model the three crop rotations, continuous corn, corn-soybean and corn-corn-soybean, which account for the great majority of crop production in the state, and three tillage systems, conventional tillage (moldboard), conservation tillage (chisel) and no till or ridge till. After simulating the optimal rotation-tillage-stover harvesting choice for each CSR, we aggregate the choices to the state totals, focusing primarily on the state-total corn and soybean production figures.

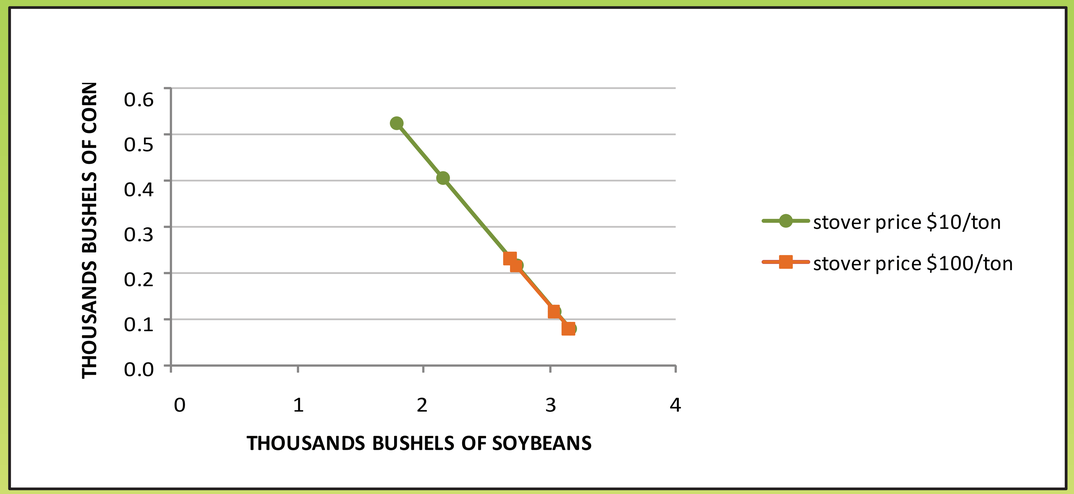


**Figure 1** Production Possibilities Frontier under alternative corn stover prices

## RESULTS

We find that since crop yields depend on the soil quality (CSR), the revenues, the costs, and the profit-maximizing choices vary with CSR. The changes in stover prices alter the profit-maximizing choices, which in turn shift the state-aggregate conditional PPF as the land of alternative land quality moves from one profit-maximizing rotation-tillage-stover collection choice to another.

The state-total figures are used to construct the production possibilities frontier (PPF) conditional on the distribution of land quality in Iowa, the current prices of major production inputs (labor, diesel, LP gas, fertilizer), for a set of hypothetical corn stover prices as suggested in the literature (e.g., English et al., 2005). We find significant shifts in the PPF due to the changes in stover prices (Table 1, Figure 1).

## ACKNOWLEDGEMENTS

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