Crop Price Volatility Impacts on Farmers’ Cropping Patterns:
A Dynamic Optimal Crop Rotation Model

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Background

- Recent increased instability in agricultural commodity prices are complicating producers’ profit-maximizing calculus.
- For maximizing these returns, producers will reallocate their acreage among crops based on commodity prices with a constraint of crop rotation considerations.
- Crop rotation maintains crop yields by controlling for disease and pests and promoting nutrients for growth.
- Research on crop rotation is generally focused on agronomy studies, while little effort has been directed toward an economic analysis.

Motivation

- For maintaining yields, producers establish a multi-year crop rotation scheme based on stable markets and production technologies. However, with volatile commodity prices, such schemes may no longer be optimal.
- If producers switch from a crop rotation scheme to mono cropping when expecting high mono crop prices, the current enhanced price may not offset any future yield reduction.
- Economic models designed to aid in such decisions would provide assistance to producers faced with uncertain price shifts.

Model

- For maximizing expected returns, at period $t$, the producer will forecast each crop price along with its yield. The single period choice problem is:

$$V(y_{it}, y_{it}) = \max_{\{n_{it}\}} \sum_{t=0}^{\infty} \beta^t \pi_n(y_{it}, y_{it}, \delta_n) \quad s.t.$$

$$\delta_n \in \Gamma(y_{it}, y_{it}, y_{it+1}) = T(y_{it}, y_{it}, \delta_n), \forall i = c, s; \forall t = 1, 2, 3, \ldots; T;
- Based on F.O.C.s, the solution to the crop choice is:

Simulation Results

- Simulation results indicate that $4.6 per bushel is the break-even price of corn for farmers to act in acreage response. The highest price in the next ten years is 4.5 which is very close to this break-even price.
- Results indicated inelasticity of producer actions in acreage allocation to volatility in crop prices.
- The results of this research are expected to provide a foundation for future related research to aid producers’ crop rotation decision in an unstable price environment.

References


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