

Endogenous R&D Investment and Market Structure:

A Case Study of the Agricultural Biotechnology Sector

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Motivation

- Why agricultural biotechnology?
 - Young (dynamic) industry
 - Property rights
 - Increasing importance in global agriculture
- Why an endogenous fixed cost (EFC) model?
 - Product quality and sunk investments in R&D
 - Levels of industry concentration bounded away from perfect competition

Research Questions

- Is the agricultural biotechnology industry, specifically the GM corn seed industry, characterized by an EFC-type model?
- How is this analysis relevant to:
 - Past consolidation activity
 - Current discussions on anticompetitive actions
 - Implications on future sector growth

The Agricultural Biotechnology Sector

- The seed industry before biotechnology
 - Innovation, IPRs, and patenting
 - Mendelian genetics and hybridization
- Consolidation and concentration: the first generation of commercialized GM crops
- Subsequent generations and renewed concerns of concentration

Data

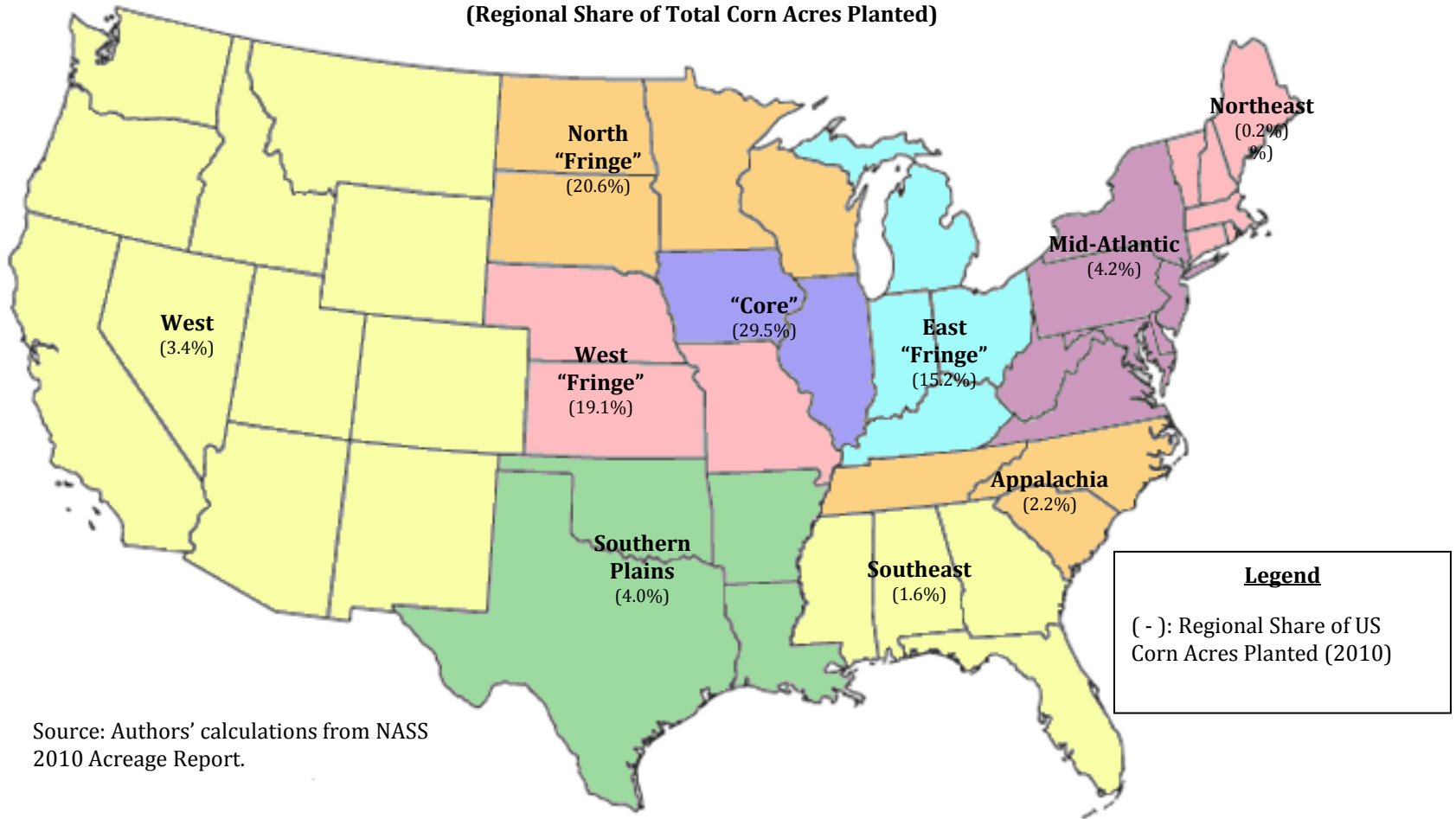
- R&D Concentration
 - APHIS Field Trial Data on applications (6697) for the release of GM crops (1990-2010)
 - Dates, phenotypes/genotypes, states
 - Petitions for deregulation (heterogeneity)
- Market Size
 - NASS Acreage Reports (1996-2010)
 - “Adoption of Genetically-Engineered Crops”, ERS data product (2000-2010)

Market Definition

- Share of total corn acres planted
- Share of corn acres planted to total cropland
- Herbicide Use
 - % of corn acres treated
 - Intensity of application (lb/acre)
- Pesticide Use
 - % of corn acres treated
 - Intensity of application (lb/acre)

Market Definition

**Figure 3: Core and Fringe Regions of the US Corn Belt
(Regional Share of Total Corn Acres Planted)**



Source: Authors' calculations from NASS 2010 Acreage Report.

Empirical Model

- Sutton (1991, 1998)
 - Ellickson (2007), Berry and Waldfoegel (2006), Marin and Siotis (2007), Dick (2007)
- Theoretical prediction: $C_1 \geq \frac{a_0}{k_0^{\beta^*}} \cdot h$
- Empirical model: $(\tilde{C}_n/h)_i = \beta_0 + \frac{\beta_1}{\ln(S/F_0)} + \varepsilon_i$
 - where $F(\varepsilon) = 1 - \exp\left\{-\left[\frac{\varepsilon - \mu}{\delta}\right]^\varphi\right\}$, $\varphi, \delta > 0$.

Concluding Remarks

- Supportive evidence for agricultural biotechnology being characterized by EFC
- Going forward:
 - Refining markets
 - Estimating model accounting for specific product traits
 - Comparison with other GM seed industry markets (soybeans/cotton)