Relating Farming Practices to Farm Productivity: Is Big Ag ‘Evil’?

The drivers of agricultural productivity and the economics of farm production have been widely studied using macroeconomic data and experiments. However, there has been relatively little research on the comparative performance of farms and farming systems. This paper highlights the need for such research through an exploratory analysis of the publicly available data of U.S. farms. The broad aim of the proposed research is to explain inter-farm differences in performance through the farmers’ choices of production and managerial practices. Given the restrictive nature of the data currently available to our research team, the presented analysis probes for directions for further empirical query rather than making causal claims on the U.S. agricultural supply chain.

U.S. agriculture industry has demonstrated outstanding productivity growth over the past half a century. Aggregate agricultural output in the U.S. has grown 3x since 1950’s, whereas the aggregate input has changed very little over this period. This rapid productivity growth has coincided with the rise of a few, gigantic agro-chemical and biotech firms — the so-called ‘Big Ag’, which came to dominate the agricultural inputs industries. The U.S. agriculture industry has been facing a whirlwind of changes during the last decades. This exploratory study provides insights into these changes in the industry and points to the current controversies that the business academia can potentially help address.

Data and Methodology Overview
The unit of analysis in this study was an individual farm. I used the publicly available Census of Agriculture 2012\(^1\) data aggregated by state and size intervals to construct what I call “study farms”. A study farm\(^2\) was meant to represent an average farm in its group of farms, e.g. an average farm in Alabama of size 10 to 49 acres. The aggregate sales revenue of each farm group were assigned as analytical weights to their respective study farms, so that the weighted sample imitated\(^3\) a representative sample of U.S. producers.

The highly detailed information on the production and organizational practices, farm finances, and farm and farm operator characteristics contained in the Census data allowed me to look at a great variety of questions on how different factors affect the farm productivity. Given the nature of the available Census data, I was not able to rule out potential endogeneity and ecological bias in the estimates, and the regression results were somewhat sensitive to the empirical model specifications. Nevertheless, I believe that these preliminary findings are quite encouraging for future research on the agricultural supply chain.

**Relating Practices to Productivity**

The last few decades have been full of changes and controversy for the industry. Big Ag has further consolidated through mergers and divestitures. Large input providers have evolved into farm-management platforms, and a diverse range of farm service providers have emerged.

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\(^1\) The Census data includes highly detailed accounts of **every farm** in the U.S. and is publicly available in various aggregated forms. I have resorted to using this publicly available resource for this preliminary study, while our research team works to gain access to data from alternative sources including micro data from various government surveys.

\(^2\) The final dataset consisted of 576 study farms representing mutually exclusive farm groups from 48 states and 12 size classes.

\(^3\) The sample statistics were indeed consistent with the figures from published farm survey results and government reports on U.S. farms. Informal tests were conducted to test whether the constructed sample accurately imitates a representative sample of U.S. farms.
Organic farming has proliferated as a radical alternative, prohibiting the use of genetically-modified seeds, and chemical pesticides and fertilizers. This study used the analysis of Census data summarized above, along with the information from various academic and public studies to provide a rich overview of the current issues in the U.S. agriculture industry. The practices of interest included:

- **Production practices and soil management:** pesticide applications and damage control practices, soil management and cover crops, tillage practices, machinery use, organic farming
- **Supply chain practices:** input costs, cost complementaries, input search
- **Organizational practices:** farm business organization, managerial practices, farm size

The most interesting findings of this study was regarding the ongoing debate about the use of genetically-modified herbicide-tolerant seeds and herbicides\(^4\). Herbicide applications are quite common, with about 70% of all operated farmland treated to control for weeds\(^5\). My analysis showed that herbicide applications and chemical expenses per acre have a positive association with the selected measures of profitability and land productivity. There also seemed to be a strong correlation between per acre spending on chemicals and seed expenses, with a dollar increase in chemical expenses associated with about $2 increase seed expenses. Interestingly, further analysis suggested that having a hired manager is associated with about $2 \textit{decrease} in the seed expenses per acre and about $25 per acre additional production value. The findings clearly indicate that managerial differences matter for the performance and the input choices of a farm.

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\(^4\) Given the limitations on the length of this extended abstract, I summarized one particularly promising discussion among many others

\(^5\) Own calculations, consistent with various government reports.