Estimating the Role of Technology in Converting to Organic Dairy Production

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Background and Motivation

- How do characteristics of production technology influence the decision of conventional dairies to convert to organic production?
- Current literature limits focus to personal characteristics and demographic variables, which only tells part of the story.
- Using US farm-level data, we show that production characteristics play an important role in the conversion decision.

Method

- Using farm-level survey data, estimate an input distance function using stochastic frontier analysis. We estimate the following production characteristics:
  - Technical Efficiency (**TE**): The ratio of *observed* output to *feasible* output, ranges from 0 (inefficient) to 1 (efficient). A firm with TE = 1 cannot obtain more output from a fixed level of input.
  - Returns to Scale (**RTS**): The amount by which output is expanded given a proportional expansion in inputs. A firm with RTS = 1.5 that increases input use by 100% will increase output by 150%.
  - Elasticity of Substitution (**EOS**): The relative ease of substituting one input for another. If EOS(Land, Capital) > EOS(Feed, Land), then the firm can more easily substitute land for capital than they can substitute feed for land.
- Match firms between 2005 and 2010 surveys to determine which firms transitioned from conventional in 2005 to organic in 2010.
- Using a discrete choice model, measure the influence of these productive characteristics and several other variables on the decision for conventional dairy farms to convert to organic practices.

Data

- Study utilizes data from the 2005 and 2010 USDA Agricultural Resource Management Surveys.

Table 1: Mean Comparison, Conventional vs. Organic

	Mean	
	Conventional	Organic
Milk Cows	358.82	88.56
Milk (cwt)	82,063.49	15,101.16
Land (acres)	681.68	367.20
Technical Efficiency	0.81	0.74
Returns to Scale	1.15	0.91
Age	53.08	47.53
% with > H.S. Education	9%	14%

Prices

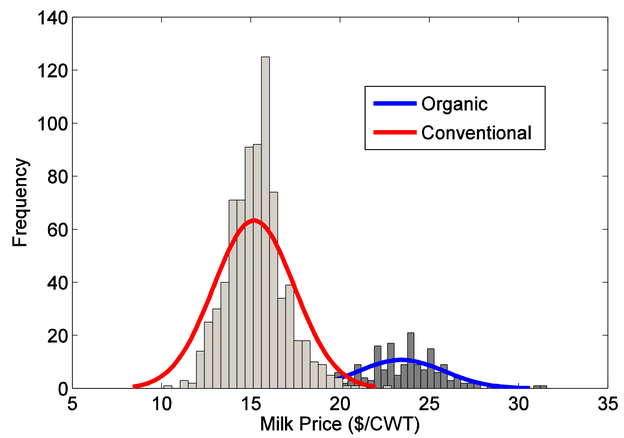

Figure 1: Milk Price Comparison (Marketing Contracts)

- The main economic incentive for converting to organic production is the price premium, demonstrated above.
- With such a high price premium, why don't more firms make the transition? Current theory suggests a simple decision rule: do the expected costs outweigh the expected benefits? This is insufficient to explain the heterogeneity in converting firms.

Production Characteristics

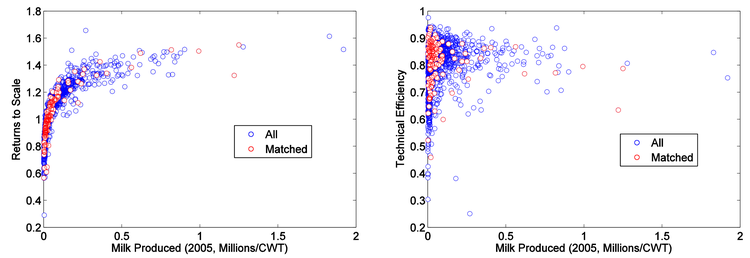

Figure 2: Relationship between Size and Production Characteristics

- Returns to scale and technical efficiency estimates are consistent with the existing literature for the dairy industry. Larger firms enjoy higher levels of RTS.
- We can only match a subset of firms between the 2005 and 2010 surveys. This figure suggests matched firms are similar to the larger sample.

Conversion Factors

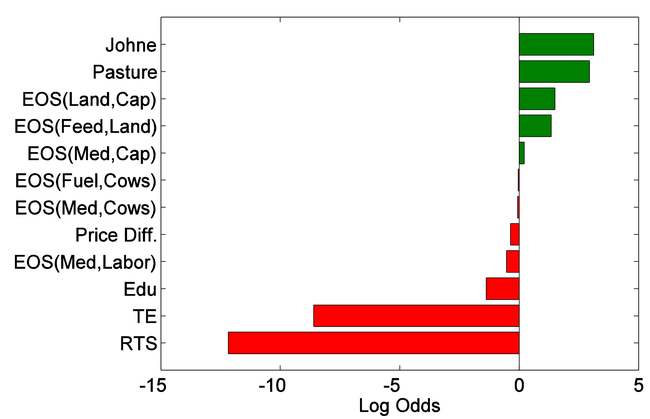

Figure 3: Impact of Different Factors on Conversion Probability

- Figure 3 displays estimates of a binary discrete choice model with dependent variable:

$$z_i = \begin{cases} 1 & \text{Converted from conventional in 2005 to organic by 2010} \\ 0 & \text{Conventional in 2005 and conventional in 2010} \end{cases}$$

- A firm's technical efficiency and returns to scale in 2005 had a large impact on whether or not they were organic by 2010, as did the elasticity of substitution between several key input combinations.
- The "Johne" variable refers to the farmer's participation in a Johne's disease prevention program. Used to proxy similar variables found in current literature. "Pasture" refers to the use of pasture for feed.
- The "Price Diff." variable captures the effect of the estimated organic price premium. It is economically and statistically insignificant.

Conclusions

- **Productive characteristics are significant factors in determining the probability of conversion to organic production practices.**
- **If firms with low returns to scale and low technical efficiency are more likely to convert, there could be firm concentration implications in both sectors.**
- **Existing conversion studies focusing only on qualitative measures are missing a key piece of the conversion puzzle.**

Acknowledgements

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