Estimating the Role of Technology in Converting to Organic Dairy Production

Tristan D. Skolrud
Ph.D. Candidate
School of Economic Sciences
Washington State University
tristan.skolrud@wsu.edu

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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.

Prices

![Milk Price Comparison](image1)

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

![Relationship between Size and Production Characteristics](image2)

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

![Impact of Different Factors on Conversion Probability](image3)

Figure 3: Impact of Different Factors on Conversion Probability

- Figure 3 displays estimates of a binary discrete choice model with dependent variable:
  \[ z = \begin{cases} 1 & \text{Converted from conventional in 2005 to organic by 2010} \\ 0 & \text{Conventional in 2005 and conventional in 2010} \end{cases} \]
- 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.

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