Is Farm Management System Significant to Explain Technical Efficiencies Differences and Technology Gap of Uruguay's Dairy Farms?

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Introduction

The productive structure of the dairy sector in Uruguay has experimented with important changes generating a remarkable dynamism. Milk production reached a sustained growth that can be explained by gains in productivity, which allowed Uruguay to become more competitive in international markets. This process of transformation implied a continuous increase in the process of technology adoption, management and organizational changes.

The principal objective of this study is to analyze technological differences between two groups of farmers, defined as family farmers (FF) versus business-managed farms (BMF). Assuming family farmers face restrictions accessing resources, like financial capital we hypothesized that the adoption of new technologies is more complicated for these FF than for BMF.

Methods

We estimate a Stochastic Meta-Frontier obtaining comparable technical efficiencies of firms in different groups that may not share the same technology. Technology gaps (MTR^k) for firms under different technologies relative to the best practice in the industry can be estimated as the difference in technology available to a given group relative to the technology available to the industry (O'Donnell et al. (2008)). Separate Stochastic Production Frontiers (SPF), are defined for each k-group of firms in the industry. After the estimation of the individual SPF, a likelihood ratio tests is applied to verify if the groups share the same technology.

The meta-frontier (MF) model is defined by Battese et al. (2004) as a deterministic parametric frontier under the restriction that the predicted value for the MF is larger than or equal to the predicted value from the SPF for all firms and groups. TE with respect to the MF (TE^*) can be estimated for each firm. The mathematical expression for $\widehat{TE_i^*}$ is:

$$\widehat{TE_i^*} = \widehat{TE_i^k} \times \widehat{MTR^k} \tag{1}$$

where $\widehat{TE_i^k}$ is technical efficiency with respect to the k-th group.

Empirical model

We estimated a translog model for each group k-group ($k = FF, BMF$),

$$y_{it}^k = \alpha_0 + \sum_{j=1}^{4} \beta j^k x_{jit}^k + \frac{1}{2} \sum_{j=1}^{4} \sum_{l=1}^{4} \beta_{jl}^k x_{jit}^k x_{lit}^k + t + \nu_{it}^k - u_{it}^k \tag{2}$$

The meta-frontier enveloping the parameters of the group frontier is calculated solving a linear program:

$$\min_{\beta} \ \bar{\mathbf{x}}'\beta$$

$$\text{s.t. } \mathbf{x}_{it}'\beta \leq \mathbf{x}_{it}'\hat{\beta}^k \tag{3}$$

Data

We use a balanced panel data containing information of dairy farms for two agricultural years, including a total of 218 observations each year. The data for the first agricultural year (2010-11) come from the General Agricultural Census carried out in 2011. Data for the second agricultural year (2013-14) was collected in a survey conducted by the National Institute of Milk (INALE) in 2014.

Parameter estimates

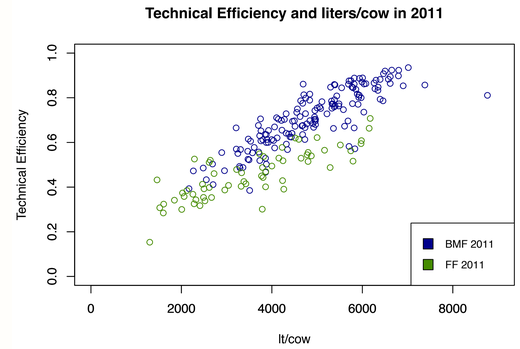
	SFA coef.		Std.Error	Meta-Frontier
Intercept	7.433	***	0.338	8.705
Cows	1.394	***	0.216	1.109
Labor	-0.306		0.200	-0.264
Pasture	0.275	**	0.124	0.089
Crops	-0.148	**	0.071	-0.036
Cows^2	-0.163	*	0.085	-0.109
Labor^2	-0.124		0.090	0.242
Pasture^2	0.005		0.017	0.041
Crops^2	0.026	**	0.013	0.039
Cows×Labor	0.170	**	0.073	0.030
Cows×Pasture	-0.018		0.039	0.010
Cows×Crops	0.038		0.024	0.049
Labor×Pasture	-0.033		0.050	-0.029
Labor×Crops	-0.040	*	0.022	-0.056
Pasture×Crops	-0.012		0.016	-0.050
t trend	0.089	**	0.036	0.093
σ^2	0.102	***	0.028	
γ	0.692	***	0.088	
μ	0.205	*	0.124	
η	0.119		0.097	

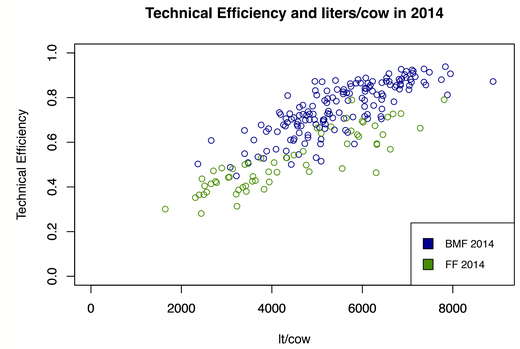
*** 1% level of significance, ** 5% level of significance, * 10% level of significance

Results

	Mean	Std Error	Minimum	Maximum
Meta-Technology Ratios				
Overall	0.908	0.097	0.391	1
Familiar	0.814	0.112	0.391	1
Non-Familiar	0.945	0.058	0.520	1
k-group Technical Efficiency				
Familiar	0.597	0.128	0.383	0.883
Non-Familiar	0.773	0.122	0.427	0.963
Meta-Frontier Technical Efficiency				
Overall	0.661	0.166	0.150	0.938
Familiar	0.486	0.123	0.150	0.794
Non-Familiar	0.731	0.124	0.406	0.938

TE distribution





Conclusions

- We find significant differences between family farms and business managed farms.
- This implies different technological trajectories for both groups.
- Family farms show larger inefficiencies than BMF allowing for improvents in productivity from better allocation of inputs rather than adopting new technology.
- We should continue exploring on the extent of the difference between trajectories to improve policy making.

References

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