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THE IMPACTS OF ORGANIC CERTIFICATION ON DAIRY FARM PERFORMANCE IN EUROPE - A LATENT CLASS COUNTERFACTUAL ANALYSIS

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Abstract: Based on a large dataset of European dairy farms and systematic counterfactual analysis, the present study aims at quantifying the economic impacts of organic certification. Gross margins and efficiency are used as key outcome variables in the analysis. Four distinct classes regroup farms which are more similar in terms of their technological choice. These are not determined a priori, but are defined through a statistical class splitting model. For the estimation of treatment effects, an endogenous treatment model is consequently used. Results suggest that organic certification makes economic sense for dairy farmers in Europe. On the basis of this model, certification effects across classes range between 38% and more than 140% in terms of profitability gains, and 0% and 5% in terms of efficiency gains.

Introduction: To date, few studies exist that rigorously evaluate the economic impact of organic certification beyond highly location- and topic-specific analysis. The novelty of the present research rests upon its scope and methodological approach. Using representative data from across 25 EU countries, results are of wide relevance and can inform cross-country policy-making. A key challenge in covering the entire European dairy sector is to account for context. By combining a latent class model with state-of-the-art impact evaluation methods for observational data, the study quantifies the context-specific effects of organic certification, using two complementary economic performance indicators. Profitability is quantified in terms of gross margins. In addition, insights are provided into the resource use efficiency of farms, using efficiency scores from stochastic frontier analysis. Taken together, these can help to explain the impacts organic certification on dairy farm performance in Europe.

Material and methods: We base our analysis on detailed economic data from the FADN database covering dairy farms in 25 EU member countries. The obtained dataset contains information on more than 40,000 dairy farms cumulated over the years 2011, 2012 and 2013, of which ca. 6% are certified organic. Inputs, apart from land, as well as output are measured in monetary terms. Cost items included in the analysis were labour, feed, forage, machinery and other costs (including expenditures for herd renewal, veterinary services and contract work). It is important to compare producers that operate under similar circumstances. In the context of efficiency analysis for example, different productions frontiers, reflecting different production technologies, may apply to different sets of farms. Efficiencies of various producers need to be estimated with respect to the appropriate technology. Producers within the same region or country may operate under different production technologies, whereas producers in different countries may use similar technologies and thus share a production frontier. Following Orea and Kumbhakar (2004), we employed a latent class model in this study to allocate dairy farms to groups that are characterised by a higher degree of homogeneity and subsequently analysed profitability and efficiency. Farms with similar attributes in selected variables are more likely to be in the same class. Optimal class size was determined by applying the Schwarz Bayesian Information Criterion (SBIC) and the rule of no small classes (Nasserinejad et al., 2017), resulting in four distinct groupings.

Gross margins and efficiency were computed precisely for farms in each of the four classes with the available data, based on per cow revenue and variable cost figures. Farm-specific efficiency scores were computed using a stochastic frontier model. This implies that a production plan is inefficient if a higher level of output is attainable for the given input use. For the estimation of the frontier model a Cobb-Douglas functional form was selected.

To obtain a valid measure of impact of organic certification, as intervention of interest, some pre-processing of the data is needed to avoid the comparison being confounded by other factors. For a systematic counterfactual analysis, producers in the comparison and treatment groups should not significantly differ in characteristics that are not related to the intervention. Due to non-random assignment, a particular challenge is self-selection bias, i.e. the fact that those producers that choose to participate in a standard often significantly differ in a number of characteristics from those producers that do not participate (Meemken and Qaim, 2018). A number of techniques to control for such a bias are available, of which matching and reweighting or instrumental variable approaches, are among the most widely used (Knook et al., 2018). While the latter can control for selection on properties that are often unobserved, such as entrepreneurship or risk behaviour, the first two rely on observable information, i.e. a dataset that captures all important variables that directly or indirectly determine selection. In the present analysis endogeneity due to unobserved properties can occur in some or all instances of the 8 class-outcome combinations. Therefore, we employ an endogenous treatment model, using the *etregress* routine in Stata. The model tests selection on unobservable characteristics and, where appropriate, corrects for such a bias (Fischer and Qaim, 2012; Tambo and Wünscher, 2014). For cases, where selection appears to be influenced only by observables, i.e. two class-outcome combinations, the analysis is complemented by a more straightforward reweighting approach (Meemken and Qaim, 2018).

Results: Contrary to a simple comparison of certified and non-certified farms, the counterfactual analysis revealed a trend of positive certification impacts across Europe (see Table 1).

Table 1: Certification impacts across four classes

	Class 1		***Class 2***		***Class 3***		***Class 4***	
	Dairy farming under cool conditions (mainly Scandinavia and Baltic)		*More intensive dairy farming under temperate conditions (mainly Central Europe)*		*More extensive dairy farming under temperate conditions (mainly Central Europe)*		*Dairy farming under warm conditions (mainly Mediterranean)*	
	GM	***EFF***	***GM***	***EFF***	***GM***	***EFF***	***GM***	***EFF***

	(€/cow)	(0-1)	(€/cow)	(0-1)	(€/cow)	(0-1)	(€/cow)	(0-1)
(1) Endogenous treatment model								
ATT	128	0.03	169	0.04	172	0.03	394	0.01
Sig.	ns	***	***	***	***	***	***	ns
Comparison	-288	0.85	409	0.87	244	0.83	267	0.85
% change	44%	4%	41%	5%	70%	3%	148%	0%
Wald test	ns	***	***	***	**	***	***	ns
(2) Entropy balancing model								
ATT	102							0.00
Sig.	***							ns
Comparison	-309							0.87
% change	38%							2%
N	5244		21,428		9,254		4,484	

Notes: ATT = Average Treatment Effect on the Treated; Comparison = Mean reference value in the comparison group; GM = Gross Margin; EFF = Efficiency; Wald test = Wald test of independent equations to test for selection on unobservable characteristics; *** = 1% significance level; **= 5% significance level; *= 10% significance level.

As the Wald test of independent equations proved highly significant in six out of eight estimations, selection on unobservable characteristics appears to be an issue here and an endogenous treatment model is appropriate. Only for two combinations results from reweighting through the entropy balancing approach are considered more fitting. The effects of organic certification vary among classes in terms of their magnitude, being consistently positive across all four classes. Differences in terms of profitability are less pronounced among the farms in cool northern European and intensive central European agricultural environments, amounting to 38% and 41%. Certification impacts on profitability are higher (ca. 70%) among the more extensive central European farms in class three. The highest effect in terms of gross margins, at 148%, was found in class four. In that group however findings indicate no significant impact in terms of efficiency. For the other three classes, efficiency effects range from 3% to 5%. The relatively small effects are mostly due to the fact that the majority of both certified and non-certified farms are operating at rather high efficiency levels.

Discussion: Based on the counterfactual framework, organic certification appears as an economically viable strategy for dairy farmers across Europe. However, due to potential market saturation, there are limits to the growth of organic dairy. Organic market development, higher sustainability standards for conventional dairy production and fairer pricing appear to be possible strategies to achieve higher economic performance in the sector. The analysis suggests no trade-offs between organic management and economic performance of a dairy farm. It should be noted that the analysis is based on monetary data, which includes premium payments. Moreover, the fact that overall efficiency levels are high implies that there is limited scope for efficiency improvement under current conditions, but a need for innovation to push out the efficiency frontier outwards.

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