Food Policy 36 (2011) 223–229

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Organic or conventional? Optimal dairy farming technology under the EU milk quota system and organic subsidies

Gunnar Breustedt *, Uwe Latacz-Lohmann, Torben Tiedemann

Department of Agricultural Economics, University of Kiel, Germany

ARTICLE INFO

Article history:
Received 29 July 2009
Received in revised form 17 September 2010
Accepted 22 November 2010
Available online 11 January 2011

Keywords:
Organic farming
EU milk quota
Data Envelopment Analysis
Organic subsidies

ABSTRACT

This paper assesses the competitiveness of organic and conventional dairy farms under different milk market and organic farming policy scenarios. We use a DEA-based model to estimate for each policy scenario the sample farms' profit potential in both technologies. The model enables identification of a farm's optimal technology based on its input–output observations. The empirical analysis is based on the annual accounts of 1300 Bavarian dairy farms. Results indicate that approximately 69% (78%) of the organic (conventional) farms have chosen their optimal farming system. The remaining organic (conventional) farmers could increase their profit on average by roughly 6% (10%) by switching to the other technology. Abolishment of the EU milk quota results in a considerable decline in the number of sample farms for which organic farming is the optimal technology, suggesting that, *ceteris paribus*, organic dairy farms may lose competitive advantage with the deregulation of the EU's milk market regime in 2015. Organic maintenance payments more than double the number of farms with a higher earning potential in organic farming, but their effectiveness could decline when the milk quota is abolished.

Introduction

Over the past 10 years, the number of organic farms in the European Union has more than doubled to about 190,000 certified organic farms in 2008 (Eurostat, 2010), representing a significant share of farms and agricultural land. On the other hand, there is evidence of organic farmers abandoning their farming system and reverting to conventional farming methods (Läpple, 2010; DEFRA, 2002). From a farmer's point of view, this raises the question of whether he or she has chosen the right technology. Policy makers may wish to know how the competitive position of organic and conventional farming systems is affected by agricultural policies and changes to them. In EU agriculture, profits from dairy farming are influenced by the EU's milk quota regime which will be discontinued in 2015. Furthermore, most EU Member States have been actively encouraging farmers to adopt organic farming practices through organic aid schemes in the Second Pillar of the Common Agricultural Policy (CAP). Some Members States and regions are currently considering or have already implemented changes to their organic aid schemes. This raises the question of how such policy changes are likely to affect the earning potential (and thus the relative competitiveness) of organic farming.

This paper sets out:

- to assess how the competitiveness of organic farming is affected by the abolishment of the EU milk quota or the discontinuation of organic aid and,
- to investigate to what extent price adjustments might alleviate the effect of these policy changes.

The analysis is based on a Data Envelope Analysis (DEA) model of technology efficiency which enables identification for each farm in the data set of its most profitable technology under alternative policy scenarios. Most comparative studies on organic and conventional farming focus on differences in productivity or technical efficiency (e.g. Tzouvelekas et al., 2001; Oude Lansink et al., 2002; Karagiannis et al., 2005; Madau, 2007; Kumbhakar et al., 2009; Mayen et al., 2009). By contrast, our model targets profit efficiency, allowing us to compute the increase in farm profit from choosing the optimal (i.e. most profitable) technology.

To assess the potential impact of policy changes on the relative competitiveness of organic dairy farming, we compare the shares of sample farms which should apply organic or conventional farming practices in the different policy scenarios. Our analysis is based on the annual accounts of more than 1200 conventional and more than one hundred organic dairy farms in the Federal State of Bavaria, Germany. The lack of reliable studies on the future of organic dairy farming after discontinuation of the EU milk quota makes our empirical analysis valuable for policy makers. It is clear

* Corresponding author. Address: Department of Agricultural Economics, University of Kiel, 24098 Kiel, Germany. Tel.: +49 431 880 4438; fax: +49 431 880 4421.
E-mail address: gbreustedt@agric-econ.uni-kiel.de (G. Breustedt).

0306-9192/$ - see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.foodpol.2010.11.019

however, that our quantitative estimates for Bavaria cannot be extrapolated to the EU milk sector as a whole.

The article is organised into three further sections. Section 2 sets out the conceptual framework of technology efficiency and presents the DEA model for conducting empirical analyses of the earning potential of farms under conventional and organic technology. Section 3 presents the data and the policy scenarios and sets out the results comparing the shares of sample farms which should use conventional or organic technology in the alternative policy settings. Section 4 summarises key results and concludes with a discussion of conceivable policy implications.

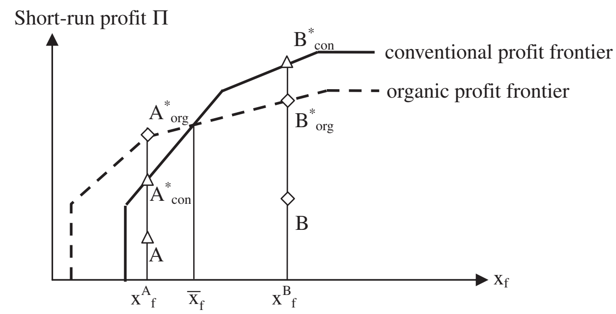

Fig. 1. Output-oriented DEA frontiers for two competing technologies.

Methodology

Whether organic or conventional dairy farming is the more profitable technology for a farm depends on factors such as differences in physical crop and livestock yields, input and output prices, opportunity costs of quasi-fixed inputs, and organic aid payments. As a consequence, the choice of farming technology is far from trivial. In this paper, we wish to determine for each individual farm the optimal technology – organic or conventional dairy farming – under different policy scenarios. This is done by comparing the profit potential of each farm under both technologies. To control for management inefficiencies we use an efficiency framework to estimating profit frontiers for both technologies, representing a farms' earning potential in conventional and organic farming, respectively.

The most common methods for estimating such frontiers are Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA). The DEA approach can be traced back to Charnes et al. (1978) who were the first to construct a non-parametric piecewise linear frontier by means of linear programming. The frontier is constructed from convex linear combinations of the inputs and outputs of efficient firms – those that generate the highest output with a given input. SFA, by contrast, is based on a regression framework. Kumbhakar et al. (2009) use SFA to estimate differences in the productivity of conventional and organic dairy farming systems in Finland. Their focus, however, is neither on profit nor on milk quota constraints.

We consider DEA to be the more appropriate methodology for evaluating the profit potential of individual dairy farms for two reasons. First, the constraints on farm-level milk sales imposed by the EU quota regime cannot be adequately represented in a standard SFA framework. The marginal impact of the milk quota on profit would hardly be interpretable in a regression framework because the *ceteris paribus* assumption does not necessarily hold. In general, a farmer will be unable to raise milk sales by extending his or her milk quota without changing other inputs at the same time. Second, our sample farms differ substantially in size. In our view, using a frontier benchmark which is influenced by 'large' farms (by Bavarian standards) with, say, over 100 cows is not appropriate for evaluating the performance of a 'small' farm with only eight cows. This, however, happens in the SFA framework by estimating the frontier's parameters. We argue with Kumbhakar et al. (2009) that SFA is appropriate when one is interested in average measures of performance of the sample farms, such as the average productivity difference between conventional and organic farming. However, if the objective is to determine whether a specific farm has chosen its most profitable technology, we prefer DEA: it constructs the benchmark for a specific farm from frontier farms of similar size and input level, thus avoiding unrealistic benchmarks being chosen.

We divide the inputs into discretionary and non-discretionary sets. The first set encompasses variable inputs X_v (such as concentrates, veterinary services, energy, contractors), which are assumed to be easily adjustable in the short term. The second set caters for the fact that in the reality of dairy farming some inputs (such as family labour, animal housing, land, or milk quota) cannot be easily adjusted in the short run. Although the flexibility of input use may differ among farmers and regions, we treat the latter inputs as non-discretionary, i.e. fixed inputs X_f for which the DEA model seeks no efficiency adjustments (Coelli et al., 2005). We measure short-run profit (subsequently simply 'profit') as revenues minus costs of variable inputs, and then search for a farm's maximum profit (profit potential) at its given level of fixed inputs. We compute each farm's profit potential for both organic and conventional technology. In so doing, we assume that a farm's level of fixed inputs X_f is the same in both technologies. Fig. 1 illustrates the conceptual model for two farms. For simplicity we refer to only one fixed input x_f. We use an output-oriented approach, that is, we focus on potential profit enhancement at a given level of fixed inputs.[1]

Consider conventional farmer *A* who uses x_f^A and earns short-run profit $\Pi(A)$ (without taking into account the cost of input x_f^A). It is clear from the conventional farming profit frontier in Fig. 1 that some benchmark farmers achieve a higher profit than $\Pi(A)$. If A were to become profit-efficient he would have to earn $\Pi(A^*_{con})$ at his given level of x_f. Profit $\Pi(A)$ relative to profit $\Pi(A^*_{con})$ is a measure of A's profit efficiency. Since this measure is less than one, A is not profit-efficient.

Let us now turn to the question of whether organic farming would be the more profitable technology for A. At input level x_f^A, we must compare the frontier profit under conventional farming $\Pi(A^*_{con})$ to the frontier profit under organic farming $\Pi(A^*_{org})$. Since the latter is higher, A could potentially earn higher profit in organic farming. The ratio of $\Pi(A^*_{org})$ to $\Pi(A^*_{con})$ thus represents a measure of technology efficiency. To compute possible profit increases from switching technologies we assume that A achieves the same profit efficiency in the alternative technology and relate the profit increase to his actual profit level.

Now consider organic farmer B. Since $\Pi(B^*_{org}) > \Pi(B)$, B is not efficient in his own technology. In addition, *B* should have chosen the other technology because $\Pi(B^*_{con}) > \Pi(B^*_{org})$. Consequently, both A and B have chosen the wrong technology. In Fig. 1, all farms which use fixed inputs below $\bar{x}_f$ should produce organically because the organic frontier lies above the conventional farms. The opposite is true for all farms with input levels greater than $\bar{x}_f$. For those farms, conventional farming offers the higher profit potential.[2]

[1] Alternatively, one could compute proportional reductions in the use of fixed inputs at constant profit levels. However, we prefer the output-oriented approach to cater for the fact that dairy farmers have limited control over the fixed inputs in the short run. Coelli et al. (2005) argue that 'one should select the orientation according to which quantities (inputs or outputs) the managers have most control over' (p. 180). Kumbhakar et al. (2009) also estimate output-oriented productivity differences between conventional and organic dairy farming.

[2] This methodological approach falls in the class of metafrontier concepts in efficiency analysis for comparing competing technologies. The metafrontier concept was set out by O'Donnell et al. (2008) and implicitly applied by Kumbhakar et al. (2009) and Karagiannis et al. (2005) to estimate productivity differences among competing technologies.