

Extended Abstract

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Paper/Poster Title	Rational Inefficiency of Innovative Dutch Arable Farmers: A DEA and Innovation Index Approach
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Abstract prepared for presentation at the 96th Annual Conference of the Agricultural Economics Society, KU Leuven, Belgium

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Abstract	200 words max
<p>Innovation is essential for increasing productivity and competitiveness in the long term, but may decrease economic performance in the short run. We verify whether early adoption of innovations constitutes rationally inefficient behaviours in the short-run. Rationally inefficient means here that innovators and early adopters are less efficient than the early and late majority of innovation adopters. We investigate the relationship between innovation and efficiency of Dutch arable farms. Innovation was measured with an agricultural innovation index adapted to the context of Dutch arable farms. We conduct a Data Envelopment Analysis to retrieve efficiency scores. We hypothesise that (1) the relationship between the innovation index and efficiency scores has an inverted U shape and (2) the most innovative farms become more efficient and expand the frontier over time. The development over time is investigated using a Markov chain analysis. Our preliminary results do not support the two hypotheses. This study has been pre-registered at AsPredicted.org.</p>	
Keywords	DEA, innovation index, rational inefficiency, Dutch arable farming
JEL Code	Q1 see: www.aeaweb.org/jel/guide/jel.php?class=Q)
Introduction	100 – 250 words
<p>Technically immature innovations use up resources: Innovators and early adopters sacrifice part of their inputs to test innovations. They forgo part of their outputs in the early adoption stages of an immature innovation. In this way, innovation can lead to technical inefficiency. While inefficiency is usually considered a form of undesirable waste (Stigler, 1976), there are also types of inefficiency that are considered rational. Following the concept of Asmild, Bogetoft & Hougaard (2013), we propose that innovators are rationally inefficient. We suggest that the inefficiency observed at innovative farms does not necessarily indicate management inefficiency, but is rational. Possibly, short-term inefficiency turns into long-term efficiency gains when innovations mature and because of first-mover advantages.</p> <p>In this paper, we investigate the rational inefficiency hypothesis in relation to innovation. We test two hypotheses. First, we hypothesise that the adoption of innovations constitutes rationally inefficient behaviour in the short-run. Second, we hypothesise that innovation front runners become more efficient or even expand the</p>	

efficiency frontier in the long-run. We expected that innovative arable farmers become efficient in the long-run.

Methodology

100 – 250 words

We use Dutch FADN and innovation monitor data and conducted an expert elicitation. We adapt the agricultural innovation index of Laple, Renwick & Thorne (2015) to the current context. The weighted index consists of four sub-indices, namely i) innovation adoption, indicating whether a certain technology has been adopted on a farm, ii) acquisition of knowledge, indicating whether farmers consulted advisory services, iii) investment in innovations and iv) continuous innovation, indicating whether machinery was renewed during the year. For the first sub-index, we selected ten technologies adopted by Dutch farmers as mentioned in their innovation monitor. Experts weighted each innovations' novelty and implementation effort in the context of Dutch arable farming systems. Each sub-indicator is weighted with the benefit-of-the-doubt index (Cherchye et al., 2007).

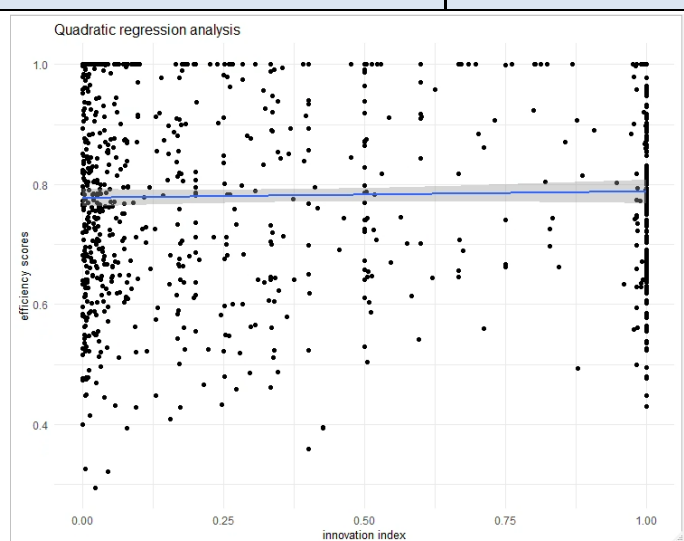
$$Innov_{yf} = w_T \sum_{t=1}^T p_t \cdot q_t \cdot z_{tyf} + w_d v_d \cdot x_{dyf} + w_r v_r \cdot z_{ryf} + w_I \cdot \frac{I_{yf}}{UAA_{yf}} + w_c \sum_y c_{yf}$$

Efficiency scores are retrieved from a Data Envelopment Analysis (Charnes, Cooper, & Rhodes, 1978). The relationship between annual farm innovation indices and efficiency scores is assessed with a quadratic regression analysis. Further, we assess the effect of a change in innovation on efficiency over time with a Markov chain analysis.

Results

100 – 250 words

We do not find sufficient evidence in support of our first hypothesis. We reject the hypothesis that the relationship between the innovation index and the efficiency scores can be described by an inverse u-shaped quadratic function. Early adopters and innovators are not less efficient than the early and late majority of innovation adopters. There is no particular relationship to be observed. The quadratic regression analysis provides estimates that are not significantly different from zero (b: 0.022, p = 0.726; b²: -0.011, p = 0.852; Intercept: 0.777, p < 0.00).



We conducted a Markov chain analysis to analyse hypothesis two. We do not find sufficient evidence to support the hypothesis that innovation front runners become multi-efficient in the long-run. There is no significant trend observable that rationally inefficient farmers become multi-efficient over time.

Discussion and Conclusion

100 – 250 words

These are preliminary results. In the discussion session of the AES conference I would like to discuss these null results and the underlying assumptions. In particular, I would like to discuss the interpretation of the statistical results and the set-up of the analysis: Is it sensible to assume that efficiency and innovation are not related? What are possible policy implications of these findings? Innovators and early adopters are as so called injection points important for the diffusion of an innovation (Barbuto, Lopolito, & Santeramo, 2019). Since sustainable innovations are important to tackle the environmental and food security challenges of our times and innovations facilitate economic growth, the diffusion of innovation should be a societal goal. Effective policy designs benefit from knowing the short- and long-term effects of innovation behaviours on efficiency. In what way can these findings guide policy designs? Is there a better way to measure how innovative a farmer is? This study has been pre-registered. What is the most honest and open way to deal with null results while drafting a compelling and interesting paper?

References

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