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ANALYSIS

Measuring farm sustainability and explaining differences in sustainable efficiency

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ABSTRACT

A major objective of European agricultural policy is to have a sustainable and efficient farming sector that is applying environmentally-friendly production methods. Policy makers aim to combine a strong economic performance and a sustainable use of natural resources. Therefore, it is important to measure and to assess farm sustainability. For a large dataset of Flemish dairy farms, a valuation method that is based on the concept of opportunity costs is used to calculate and analyze differences among the sample farms with respect to the creation of “sustainable value”. But more important than measuring the creation of sustainable value is to analyze differences in sustainable efficiency. Therefore, sustainable efficiency measures are calculated and differences in sustainable efficiency are explained. Using panel data, an effect model captures the determinants of sustainable efficiency of the studied farms. The empirical model shows that, in general, larger farms have a higher sustainable efficiency. Also farmer's age and dependency on support payments proved to be determining characteristics for observed differences in sustainable efficiency.

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1. Introduction

One of the major objectives of European agricultural policy is to have a sustainable and efficient farming sector, which uses safe and environmental-friendly production methods and provides quality products that meet consumers' demands. Sustainability is seen as a key element towards a profitable long-term future for farming and rural areas. Policy makers aim to combine strong economic performance with the sustainable use of natural resources in the field of agriculture (Boel, 2005; European Commission, 2004).

An important conclusion of the United Nations Conference on Environment and Development in 1992 is that the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production (United Nations, 1992, pp. 18). While sustainable consumption targets consumers, sustainable production is related to companies or organisations that make products or offer services (Veleva and Ellenbecker, 2001). Despite the difficulty of defining sustainable production and the vagueness of several definitions, there is a clear consensus to move from definition attempts toward developing and using concrete tools for measuring and promoting actual sustainability achievements.

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To meet with the challenges of sustainability, an approach for integrated assessment of companies is required to provide a good guidance for decision-making (Krajnc and Glavic, 2005a). Therefore, it is important to measure and to assess farm sustainability. The aim of this research is to measure the sustainability of dairy farms in terms of 'sustainable value' and 'sustainable efficiency' and to find out why farms differ in sustainable efficiency. The Flemish dairy sector is used as test-case and example to identify farm sustainability. Using a large data set, the sustainable value creation of dairy farms and its evolution during 1995–2001 is analyzed. Further, the robustness of our results is tested by using different benchmarks for calculating sustainable efficiency. The existence of frontrunners and laggards among dairy farms is investigated by testing whether good/bad farm performance is repeated from year to year. Furthermore, possible causes of observed differences are studied using an empirical model. Finally, the link between partial productivity measures, eco-efficiency measures and sustainable efficiency is analyzed.

2. Theoretical framework

Pezzey and Toman (2002, pp. 1) state that: "concern about sustainability is almost as old and enduring as the dismal science itself, though the word itself has come into fashion only in the past decades". Since the publication of *Our Common Future* by the World Commission on Environment and Development (WCED, 1987), the idea of sustainable development came to the forefront of the public debate. This World Commission added its voice to the appeal for new ways of measuring progress that would go beyond economic signals and capture a fuller sense of human and ecological well-being (Hardi and Zdan, 1997). However, sustainability proved to be a remarkably difficult concept to define and to apply in practice. Moreover, relevant 'measurement' of sustainability is fraught with difficulties of principles and practice. Hence, there are, understandably, but nevertheless disappointingly, rather few published empirical studies on this topic (Pezzey and Toman, 2002).

The need for procedures to measure sustainability is increasingly recognized (Tyteca, 1998). Although the concept has different meanings to different people, it is far from meaningless (Farrell and Hart, 1998). Indicators can help to identify, define and communicate about sustainability issues and they can be used to forecast and monitor the results of policy choices (ESDI, s.d.). Good indicators provide key information about a physical, a social or an economic system and they allow analysis of trends and cause-and-effect relationships (Veleva and Ellenbecker, 2001). Moreover, indicators of sustainable development should provide solid bases for decision making at all levels (Becker, 1997; Capello and Nijkamp, 2002). Decision makers need indicators that show the links between social, environmental and economic goals to better understand how to achieve economic growth that is in harmony with the natural systems within which we live and work (Farrell and Hart, 1998).

Indicators can be used (i) individually, (ii) as part of a set, or (iii) in the form of a composite index that combines individual indicator scores into a single number. Such a single aggregated number can be very useful in communicating information on

general sustainability to the public and to decision makers (Farrell and Hart, 1998). Possible disadvantages are that the methods to achieve an aggregation are often subjective (Becker, 1997; Huetting and Reijnders, 2004) and that every index contains hidden assumptions and simplifications (Hanley et al., 1999). Therefore, such combined indicators need to be used judiciously. Farrell and Hart (1998) state that in many cases, indicators to measure sustainability are no more than combined lists of traditional economic, environmental and social indicators with the word 'sustainable' added to the title. Nevertheless, such combination is a first significant step because it recognizes that all three areas (economic, ecological and social) matter: sustainable development is a holistic concept and ideally one should strive to consider all three pillars of sustainability simultaneously. Therefore, it is important that the development of indicators does not stop at this stage (Farrell and Hart, 1998). Economic and ecological analysis need to be combined (Kaufmann and Cleveland, 1995) and one should concentrate on the interaction rather than on just the environment itself (Jollands et al., 2003). The advantage of aggregate indicators is that the information is presented in a format tailored to decision makers (Constanza, 2000; Jollands et al., 2003; Azapagic, 2004). However, we need to be careful and informed about the way of aggregation, the uncertainties, the weights and the data source. Decision makers are too busy to deal with these details and the beauty of the aggregate indicator is the fact that it does the job for them (Constanza, 2000). But, no single indicator can possibly answer all questions and therefore multi-dimensional indicators can be needed (Opschoor, 2000; Veleva and Ellenbecker, 2001).

In recent years, different frameworks and indicator systems have emerged that claim to evaluate sustainability both at firm level and at higher level. Most of the focus in measuring and evaluating progress towards sustainable development has been at the national level (Veleva and Ellenbecker, 2000; Figge and Hahn, 2004a). Well known examples are the ecological footprints (e.g. Wackernagel and Rees, 1995), genuine savings (e.g. Pearce and Atkinson, 1993), the index of sustainable economic welfare (e.g. Daly and Cobb, 1989), and the dashboard of sustainability (e.g. IISD, s.d.).

Sustainability is a global concept and a firm is only a small subsystem that interacts in various ways with surrounding systems. Nevertheless, companies are essential actors in socio-economic life and as such they contribute to the realization of sustainable development (Tyteca, 1998). Corporations are the organisations with the resources, the technology, the global reach, and ultimately, the motivation to achieve sustainability (Hart, 1997). Defining and measuring corporate sustainability is more than just an academic concern. Corporate entities are increasingly under pressure to demonstrate how they contribute to the national sustainability goals outlined by governments (Atkinson, 2000). The concept behind sustainability indicators for business is simple. On the one hand, the aim of these indicators is to answer the question of how one might objectively know whether a company is moving towards or away from sustainability in all three dimensions: environmental, social and economic (Lawrence, 1997). On the other hand, defining the appropriate indicators is not easy (Veleva and Ellenbecker, 2000).

Assessing a company's contribution to sustainability can be measured by subtracting the costs from the benefits

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