Europ. J. Agronomy 79 (2016) 100–106

Contents lists available at ScienceDirect

European Journal of Agronomy

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

An empirical analysis of risk in conventional and organic arable farming in The Netherlands

P.B.M. Berentsen[a,*], M.A.P.M. van Asseldonk[b]

[a] Business Economics Group, Wageningen University, Hollandseweg 1, 6706 KN, Wageningen, The Netherlands
[b] Agricultural Economics Research Institute, Wageningen University and Research Centre, Hollandseweg 1, 6706 KN, Wageningen, The Netherlands

ARTICLE INFO

Article history:
Received 10 December 2015
Received in revised form 27 May 2016
Accepted 6 June 2016

Keywords:
Arable farming
Organic farming
Risk assessment
Error component implicit detrending method

ABSTRACT

This paper assesses and compares risk in conventional and organic arable farming in The Netherlands with respect to family farm income and underlying price and production variables. To investigate the risk factors the farm accountancy data network was used containing unbalanced panel data from 196 conventional and 29 organic representative Dutch arable farms (for the period 2002 up to and including 2011). Variables with regard to price and production risk were identified using a family farm income analysis scheme. Price risk variables are input and output prices, while yield volatility of different crops is the main production risk variable. To assess risk, an error components implicit detrending method was applied and the resulting detrended standard deviations were compared between conventional and organic farms. Results indicate that the risk at the level of family farm income is higher in organic farming. The underlying variables show higher risk for organic farms in crop yields, crop prices and variable input costs per crop.

1. Introduction

Adverse environmental effects of conventional agricultural production systems have increased the demand for more sustainable production systems. Organic farming is recognized as a possible way forward to improve sustainability in agriculture (Tuomisto et al., 2012; Rigby and Caceres, 2001). The focus of organic agriculture on the environment is clearly stated by the European Commission who characterizes organic farming as farming that "relies on a number of objectives and principles as well as common practices, designed to minimise the human impact on the environment, while ensuring the agricultural system operates as naturally as possible" (EU, 2015). From this characterization follow EU production rules about organic farming that have to be respected in order to label the products as organic. For arable farming these are rules as (1) prohibition of the use of synthetic fertilizers and synthetic pesticides and herbicides, (2) the requirement to use only seeding material and propagating material produced organically, and (3) the requirement to apply wide crop rotations. The downside effects of these rules are that yields in organic production are generally lower than in conventional production while yield variability generally is higher (Stockdale et al., 2001). These downside effects are generally compensated by higher farm gate prices for organic products. This leads to the general impression that organic farming is characterized by higher income levels but also by higher risk levels.

Empirical research on comparing risk between conventional and organic arable farming can be divided into studies that take the farm level as the level of analysis (e.g. Tiedemann and Latacz-Lohmann, 2013; Gardebroek et al., 2010; Serra et al., 2008) and studies that focus on crop level (e.g. Palmer et al., 2013; Delmotte et al., 2011). Studies of the former type have in common that outputs are always aggregated on a revenue basis while the level of aggregation of inputs differs between studies. The use of aggregated revenues limits the value of a study as it does not allow for analysing separately price and yield risk, and it also does not allow for risk analysis at crop level. The combination of farm level and crop level risk analysis is highly relevant for arable farming as arable farms are typically set up as diversified multi-commodity operations. While this may partly be based on agronomic grounds, it likewise has important impacts on the farm-level risk exposure. Volatility at farm level is caused by joint volatility in variable input costs, crop yields and output prices of crops cultivated within the farm portfolio. Stud-

* Corresponding author.
E-mail addresses: paul.berentsen@wur.nl (P.B.M. Berentsen), marcel.vanasseldonk@wur.nl (M.A.P.M. van Asseldonk).

http://dx.doi.org/10.1016/j.eja.2016.06.002
1161-0301/

ies at crop level focus, for example, on yields and yield variation of potatoes (Palmer et al., 2013) and of rice (Delmotte et al., 2011). As these studies do not take into account price risk, the contribution to an analysis of farm level income risk is limited. The current study tries to combine both approaches in order to be able to draw conclusions about differences in risk between conventional and organic arable farming both at the level of the farm income and at the level of individual crops.

The objective of this paper is to compare income risk of conventional and organic arable farms in The Netherlands and to trace back the income risk to production and price risk of the main crops. The basis for this is representative data for The Netherlands from both conventional and organic arable farms over a period of ten years. Risk measured in this paper both in absolute terms, as standard deviation (SD), and in relative terms, as coefficient of variation (CV).

2. Materials and methods

2.1. Description of the data

The analysis is based on Dutch arable farm data for the years 2002–2011 recorded via the Farm Accountancy Data Network (FADN) of the Agricultural Economics Research Institute in The Netherlands. FADN consists of an annual survey carried out by the member states of the European Union. To assure representative data, in each member state a random stratified sample is constructed, including around 2% of the farms, and based on three criteria: region, economic size and type of farming. Type of farming indicates the most important agricultural activity or set of activities on a farm, for example arable farming, dairy farming or mixed farming. For arable and dairy farming the type of farming includes both conventional and organic farming systems. The survey is a rotating survey, meaning that the number of years farms are in the survey can differ among farms (i.e. unbalanced panel). The advantage of FADN is that it is a harmonized data source with similar bookkeeping principles in all member states. A further advantage, which is explicitly used in this research, is the micro economic nature of the data source. Detailed information is available of individual farms, which provides the opportunity to conduct analysis at farm level and which gives insight in the distribution and differences in incomes between farms. Furthermore it makes it possible to follow the performance of a farm during consecutive years (Court of Auditors, 2004).

The total number of specialised arable farms in the database available for this analysis was 287. Because of the interest in within farm volatility, farms that were only one or two years in the database were excluded from the analysis. Of the remaining farms (225) the majority were conventional farms (196) while 29 were organic. The farms in the database are either conventional or organic for the whole period they are in the sample, so farms in transition between conventional and organic are not included. The average number of years farms were in the in the database is 6.9 for conventional and 5.8 for organic farms.

Each individual farm in the sample has a sample weight indicating the number of farms in the total population that are represented by each particular farm. Due to the fact that the strata in the population (used for the stratified sample) are different in size and in homogeneity, weights can differ between sample farms. Due to the continuously changing population (some farms exit, while others expand) even the weight of each individual farm in the sample can change over the years.

The database contains both technical and economic variables. A distinction can be made between variables on farm structure, like availability of land (on average 61 ha for conventional and 48 ha for organic farms) and of other assets, and variables indicating how well the farm is managed, ranging from yields per ha for different crops to family farm income.

2.2. Selection of risk variables

Risk in arable farming consists mainly of production and price risk of inputs and produced outputs. Production risk of output stems from weather uncertainty affecting crop yield and from inherent uncertainty in crop production (e.g., plant diseases). Price risk of outputs stems from uncertainty in market conditions (e.g. supply and demand) and from uncertainty in product quality which follows for an important part from weather conditions. Also on the input side there can be variation in prices of inputs (and amounts required). At the level of individual crops, however, the database only contains the costs of different inputs, so a distinction between amount and price regarding inputs cannot be made. All these factors together jointly cause income risk. The analysed risk variables in this paper are depicted in Fig. 1. This analysis scheme captures the relation between technical and economic variables and the family farm income. The relations between the variables in the analysis scheme are arithmetic which means that a variable can be calculated from its underlying variables. The grey boxes in Fig. 1 represent the variables which are considered with regard to analysis of price and production risk. Price risk is captured by the variance in crop prices. Production risk is included in the variance in crop yields. Variance in variable cost components captures both price and production risk. With regard to paid labour it should be noted that cost of paid labour is not available per crop but only at the farm level. Fixed cost is excluded from the analysis because this has by definition a low variance, so there is a low risk contribution.

2.3. Method of analysis

Differences in risk between conventional and organic farming follow from differences in the within farm standard deviations (SD's) of the variables described in the previous section. For a proper comparison a farm specific approach is essential, meaning that farm individual data need to be detrended for general observed trends like weather variability (Flaten et al., 2011). A reason for doing so is that the series of individual farm data are not all from the same period. An example may explain this. Suppose the SD's of yields of a certain crop of two farms are compared in order to determine their risk exposures. Next, suppose the available data of the first farm spans from 2001 to 2005 while those of the second farm spans from 2004 to 2007. Now suppose that 2006 was a very dry year with extremely low crop yield all over the country. This would amplify the SD of production of the second farm while this phenomenon is not specific for that particular farm. This could erroneously lead to the conclusion that in general the SD of the particular crop yield of the second farm is higher than on the first farm. A basic assumption for detrending is that all farms, conventional and organic, are impacted in a similar way by the phenomenon that causes the trends, but the size of the impact might differ between farms.

Following Atwood et al. (2003) and Flaten et al. (2011) detrending was done by means of an Error Components Implicit Detrending (ECID) procedure. This includes four successive steps (using wheat yield as an example) to derive time variant farm specific deviations:

a) Compute the overall national average wheat yield per ha (Y_{nat}) in each year (t), $Y_{nat,t}$,;
b) Compute the yield deviation (Δ) of each farm i from the national yield for each year t the farm is in the sample:

$$\Delta_{i,t} = Y_{i,t} - Y_{nat,t} (1)$$