Farmer's objectives as determinant factors of organic farming adoption

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Abstract. Our paper seeks to assess the decision to adopt organic farming practices. More specifically, we use *Duration Analysis* (DA) to determine why farmers adopt organic farming and the timing of adoption. We extend previous studies by including farmers’ objectives, risk preferences and agricultural policies as covariates in the DA model. The *Analytical Hierarchy Process* (AHP) is used as a multi-criteria decision-making methodology to measure farmers’ objectives. The empirical analysis uses farm-level data collected through a questionnaire to a sample of vineyard holdings in the Spanish region of Catalonia. Farmers’ objectives are found to influence the conversion decision. Moreover, farmers who are not risk averse are more prone to adopt organic farming. Results also identify the policy changes that have been more relevant in motivating adoption of organic practices.

Keywords: Organic farming adoption, Duration Analysis, Analytical Hierarchy Process, farmers’ objectives.

1. Introduction and objectives

During the last few decades the European agriculture has been intensifying its production practices. Concerns and awareness about the negative externalities on humans, animals and the environment have been growing. In order to reduce the negative impacts derived from intensive farming, some environmentally friendly production methods such as organic agriculture have been promoted by EU public authorities. Organic agriculture mainly relies on non-polluting inputs and the management of the ecosystem as a whole. Synthetic inputs such as fertilizers or pesticides, veterinary drugs, and genetically modified seeds are replaced, whenever possible, by agronomic, biological and mechanical methods adapted to local conditions and needs.

Organic farming, which has increased substantially in recent years, has received important attention within the Common Agricultural Policy (CAP). The CAP has provided support to organic farming since 1991 by means of a premium subsidy program whereby farmers receive a fixed payment per crop and year (Regulation 2078/91). In 1999, another Regulation (1257/1999) was approved with the aim of improving the efficacy of organic farming started in 1991. The present support scheme for organic agriculture will be applied until 2013 under the rural development Regulation 1463/2006. Recently, Regulation 889/2008 was passed with the objective of ensuring a fair competition and a proper functioning of the internal market in organic products, and maintaining consumer confidence in products labeled as organic.

There have been several studies that attempt to explain the determinants of adoption of organic production systems. Different approaches have been implemented for this purpose; a) the *adoption* approach which usually relies upon cross-sectional data which is analyzed by means of probability models to assess the likelihood that conversion occurs (Isin *et al*., 2007; Genius *et al*., 2006; De Cock, 2005; Rigby and Young, 2005; Anderson *et al*., 2005 and Calatrava and González, 2008), b) the *diffusion* approach which deals with the cumulative adoption rate at the aggregate level using time-series data (Feder and Umali, 1993; Gardebroek and Jongeneel, 2004), c) the *impact* approach that focuses on the impact of conversion on the physical and financial performance of organic farms, by employing linear mathematical programming and simulation methods (Musshoff and Hirschauer, 2008; Acs *et al*., 2007 and Kerselaers *et al*., 2007) and e) the *comparison* approach that compares organic and conventional farming in various management aspects such as input use, efficiency, productivity, as well as economic results, using basic statistics or profit maximization models, among other methods (Serra *et al*., 2007; Cisilino and Madau, 2007; Oude Lansink and Jensma, 2003; OECD, 2000; Tzouvelekas *et al*., 2001 and Klepper *et al*., 1977).

While the adoption approach fails to allow for the timing of the adoption of organic farming and the impact that time-varying factors may have on it, diffusion studies do not address the issue of why a particular farm adopts earlier than others (Burton *et al.*, 2003). An alternative approach is Duration Analysis (DA) which is capable of analyzing both the decision and diffusion aspects of organic farming adoption. This is accomplished by analyzing cross-sectional and time-variant data jointly in a dynamic framework (McWilliams and Zilberman, 1996). The DA allows determining not only why farmers adopt organic farming, but also the timing of adoption and the factors that influence the observed time patterns. DA allows for changes in the explanatory factors both across farmers and time, thus studying adoption and diffusion together.

Though DA was originally used in biometrics research, it has been applied in a wide range of analyses such as the duration of marriages, spacing births, time to adopt new technologies, product durability, occupational mobility, lifetime of firms, durations of wars, time from initiation to resolution of legal cases (Kiefer, 1988 and Lancaster, 1992), etc. The first application in economics was carried out by Lancaster (1978) in the field of labor economics, to analyze the duration of unemployment and the rates of entry and exit.

In agriculture, DA has been recently applied in different adoption studies such as the adoption of conservation tillage (Fuglie and Kascak, 2001; and D'Emden *et al.*, 2006), animal and plant breeding (Abdulai and Huffman, 2005; and Matuschke and Qaim 2008), input innovation (Dadi *et al*., 2004), and sustainable technology adoption (De Souza *et al*., 1998). Only a few analyses have used the DA to assess the adoption of organic farming practices: the published paper by Burton *et al*. (2003) and the unpublished manuscript by Hattam and Holloway (2007).

Our paper aims to analyze the adoption of organic practices in the vineyard sector in the Spanish region of Catalonia by making use of DA. We seek to assess the influence of farmer characteristics, attitudes and opinions, farm structure, farm management results and other exogenous factors on adoption. In this context, our work contributes to previous literature by extending DA analysis to a consideration of farmer objectives as relevant factors in explaining the decision to convert. Our analysis also makes a thorough exploration of the role of farmers' attitudes and opinions in organic farming adoption and introduces farmers' risk preferences into the model. Additionally, we seek to analyze the impact of agricultural policy instruments on the duration of adoption. Another contribution of this article is the consideration of the *random censoring* feature that characterizes all organic adoption data and which has not been addressed before. Finally, this paper contributes to the scarce literature on the duration of organic adoption. In this context, there are no currently published studies on this topic in Spain.

The determinants of organic farming adoption can be classified into two broad groups: non-economic and economic factors. The former group includes farmer's attitudes, opinions and objectives as relevant elements. In the later group we mainly find market prices, profit making and public support. Most studies (Burton *et al*., 1999; Rigby *et al*., 2001; or Padel, 2001) that have analyzed the adoption of organic farming have found the relevance of both types of factors. In this line, attitudes and preferences are important determinants of adoption decisions (De Cock, 2005; De Souza *et al*., 1999; Burton *et al*., 1999 and Ajzen and Fishebin, 1977). While differences in attitudes and opinions between organic and conventional farmers can contribute to explain conversion, they can usually interact and influence each other in a complex form (De Cock, 2005). To capture and simplify this complexity, we use the *Principal Components Analysis* (PCA). The resulting factors from PCA are used as explanatory variables of organic adoption. Moreover, we use the *Analytical Hierarchy Process* (AHP) as a multi-criteria decision-making methodology to measure farmers' objectives and we include these measures as covariates in the DA.

The remainder of this paper is organized as follows. Section 2 provides details on the organic sector in Spain and Catalonia. The third section explores studies on adoption in agriculture. In Sections 4 and 5, we present the conceptual framework and the empirical application, respectively. Results are discussed in section 6. Finally, some conclusions are outlined.

2. The organic agriculture sector

Organic agriculture has experienced rapid growth worldwide with currently 31 million ha being managed organically by at least 623,174 farms (Willer and Yussefi, 2006). Australia occupies the first position with 12.1 million ha, followed by the EU (6.6 million ha), China (3.5 million ha) and Argentina (2.8 million ha).

In the EU the organic area represents 3.6% of the total utilized agricultural area (UAA) which is managed by 165,330 organic farms (FIBL, 2007). Italy holds the largest organic area within the EU (1,067,102 ha managed by 44,733 organic farms), followed by Germany (833,000 ha and 17,282 organic farms) and Spain (926,390 ha and 17,241 organic farms). If we rank EU countries according to the relative importance of the organic area within the total UAA, Spain occupies the 14th place with 3.7%. In the first positions we find Austria (14.2%) and Italy (8.4%), followed by Sweden, Portugal, Finland and Estonia with approximately 6.5% of their UAA.

In Spain, the average size of an organic farm is about 51.5 ha, which is above the European average size (37.7 ha). Within the last 15 years the Spanish organic sector, as in most European countries, has experienced spectacular growth. While in 1991 there were only 369 organic operators, there are currently 19,211 organic operators, of which 76.9% cultivate crops and 12.6% are livestock growers, according to the most recent available statistics (MARM, 2007). The remaining percentage represents processors and importers. The most important organic crops in Spain are cereals and pulses (12.23%), olives (10.09%), nuts (4.81%) and vineyards (1.82%).

Spanish organic farming was at first regulated by a generic "organic produce" brand introduced in 1989. Initially, the national Board for Organic Agriculture was in charge of controlling production throughout the country. In 1993, the control was handed over to the regional authorities. In 2000, a logotype was created to be voluntarily used in the labeling of organic products. Recently, the National Organic Action Plan (2007 - 2010) has been approved in order to apply a set of specific actions on organic farming, organic produce processing, marketing, distribution and consumption, and also on the education and research areas (MARM, 2007).

Catalonia is one of the most important regions within Spain in organic farming. It occupies the fourth place in the distribution of the Spanish organic area (5.96%), after Andalucía (57.90%), Aragón (7.50%) and Extremadura (6.95%). The Catalan sector also occupies the fourth position within the Spanish vineyard organic sector, representing 8.18% of the total area (MARM, 2007). Over the last decade, the Catalan organic vineyard sector has experienced the fastest growth within the Catalan organic sector, with an increase on the order of 565.06% from 1995 to 2006. Vineyard growth rates are followed by those experienced by cereals and pulses (355.11%), vegetables (318.39%), olive groves (168.29%) and nuts (23.03%).

Catalonia has 147 registered organic vineyard farmers that represent the targeted organic population in our study. The decision to focus on this activity is based on various factors: a) the decision to go organic in this sector is not very likely to be subsidy-driven. It is more likely to be motivated by market conditions due to the high added value of its final product, b) the rapid growth of the Catalan organic vineyard sector compared to other sectors since 1995, and c) its relative weight within the total organic sector in both Spain and Catalonia.

3. Determinants of adoption in agriculture

Several studies (Knowler and Bradshaw, 2007; Rigby *et al*., 2001; Padel, 2001 and Lampkin and Padel, 1994) have reviewed and summarized the factors that influence adoption decisions in agriculture. Rigby *et al*. (2001), Padel (2001), or Knowler and Bradshaw (2007) have focused their revision on organic farming. We update these latter revisions by listing new applications and studies, their applied methodology and sample size (Table 1). According to the studies reviewed, the most relevant factors that can influence the decision to convert from conventional to organic farming include:

1. *Farmer Characteristics*: gender, education, age, experience, etc.
2. *Farm Structure*: location, farm size, soil type, machinery, etc.
3. *Farm Management:* input use, crop diversification, crop rotation, etc.
4. *Exogenous factors*: output and input prices, market size, subsidies, information access, transition costs, policy reforms, etc.
5. *Attitudes and opinions*: farmer beliefs about the environment, acceptance within the rural community, life style, health and environmental preoccupations, etc.

Table 1: Studies that analyze organic farming adoption and its determinants

Study	Sample Size		Method of analysis
	Organic	Conventional	
Acs *et al*. (2007)			Dynamic linear programming
Albisu and Laajimi (1998)	97	125	Probit Model
Anderson *et al*. (2005)	28	118	Multinomial and Logit model
Calatrava and González (2008)	254		Ordered Probit model
Darnhofer *et al*. (2005)	9	12	Decision tree modelling
De Cock (2005)	93	190	Ordered Probit model
Fairweather (1999)	16	27	Decision tree modelling
Gardebroek and Jongeneel (2004)	16	-	Bayesian approach
Genius *et al*. (2006)	44	118	Ordered Probit model
Hanson *et al*. (2004)	61	-	Focus group
Hattam and Holloway (2004)	47	186	Probit model
Isin *et al*. (2007)	20	107	Probit model
Kerselaers *et al*. (2007)	-	685	Linear programming
Lohr and Salomonsson (2000)	234	316	Probit model
Musshoff and Hirschauer (2008)			Investment under uncertainty
Parra and Calatrava (2005)	161	161	Logit model
Pietola and Oude Lansink (2001)	169	779	Switching–type Probit
Rigby and Young (2005)	86	35	Logit model
Wossink and Kuminoff (2005)	80	167	Option theory
Comparison between organic and conventional studies			
Cisilino and Madau (2007)	115	114	Data Envelopment Analysis
Klepper *et al*. (1977)	14	14	Basic statistics
OECD (2000)	-	-	Basic statistics
Oude Lansink and Jensma (2003)	29	571	Profit maximization model
Serra *et al*. (2008)	68	3,643	Utility maximization model
Zhengfei *et al*. (2005)	28	405	Damage control model

In Table 2 we present a summary of the variables that usually explain organic farming adoption and the impact they generally have on the decision to adopt. Young women with high levels of education are more likely to adopt. Conversely, older farmers with relevant social networks are less prone to convert. Adoption is also higher among family farms, farms with steep slope land, high soil quality and with easy access to water. Other farmer characteristics can also influence positively the decision to convert. Farmers who are concerned with environmental problems, food safety and soil degradation are more prone to adopt. Further, these farmers tend to use internet technology when managing the farm. With regards to the economic variables, we state the importance of policy support and price premiums as determinant factors of conversion.

Table 2: Direction of the relationship between variables and decision to adopt

Variables	***Direction of the effect***	***Variables***	***Direction of the effect***
Education	+	Risk lover	+
Age	–	Ease of obtaining information	
Gender/woman	+	Experience and skills	–
Farm size	–	Debt level	–
Off-farm activities	+	Difficulties in getting loans	-
Land slope	+	Farm manager urban background	+
Cold climate	+	Distance between farm and home	–
Positive attitudes toward conversion	+	Closeness of family to farm	–
Concerns on soil erosion	+	Number of soil analyses per year	+
Water availability	+	Use of the internet and e-mails	+
Soil quality	+	Proximity of the holding to organic farms	+
Family labor in farm	+	Number of organic farms around	+
Total labor in farm	+	Course and conference assistance	+
Number of information source	+	Membership of an environmental organization	+
Opinion in favor of preserving the environment	+	Concerns about family health	+
Member of a producers' association	+	Policy support	+
Positive perceptions toward organic farming	+	Concerns about food safety	+
Concerns about soil degradation	+	Social contact	–

Source: Own elaboration based on literature review shown in Table 1

4. Methods

The five main groups of variables explaining adoption in agriculture and identified by the literature review in the previous section are used in our analysis. As noted these groups are *Farmer characteristics* (F_i), *Farm structure* (S_i), *Farm management and results* (M_i), *Exogenous factors* (E_i), and *Attitudes and opinions* (A_i). We contribute to previous literature by also including another set of variables representing *Farmers' objectives* (O_i). Farmers' attitudes and opinions are summarized into factors by using the *Principal Components Analysis* (PCA) and farmers' objectives are measured by applying Analytical Hierarchy Process (AHP) techniques. Below we offer details on AHP and DA methodologies.

4.1. The Analytical Hierarchy Process (AHP)

As mentioned before, we hypothesize that farmers' objectives can play an important role in determining the adoption of organic practices (De Cock, 2005). However, to collect information about the relative importance of each objective for each farmer is usually a complicated task. To overcome this difficulty, we use the AHP methodology that measures and determines the relative importance of farmers' objectives, allowing us to use the results as a covariate in the DA model. The AHP is a technique (Saaty, 1977, 1980) to support multi-criteria decision-making in discrete environments. AHP allows us to weigh each farmer's objectives and use them to explain production decisions. In order to implement the AHP, one needs to carry out a survey where individuals are asked to value different objectives that follow a hierarchical structure (figure 1). We distinguish between economic, environmental and socio-cultural objectives. Each objective in the tree is divided into three different sub-objectives to be also valued.

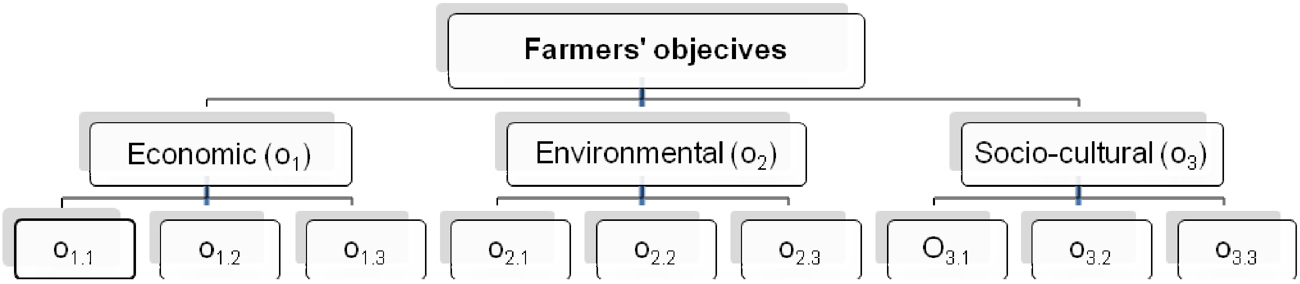

Figure 1: Hierarchical structure used to value conventional and organic farmers' objectives

The relative importance or weight (w_i) of objectives are obtained from paired comparisons. In order to make these comparisons and determine the intensity of preferences for each option, Saaty (1980) proposed and justified the use of a 1 to 9 scale. The relative importance of each objective is obtained by comparing this objective with all other objectives. From the answers provided, a matrix with the following structure is generated for each individual (k) (Saaty matrix):

$$A_k = \begin{bmatrix} a_{11k} & a_{12k} & \dots & a_{1nk} \\ a_{21k} & a_{22k} & \dots & a_{2nk} \\ \dots & \dots & a_{iik} & \dots \\ a_{n1k} & a_{n2k} & \dots & a_{nnk} \end{bmatrix} \qquad (1)$$

where a_{ijk} represents the value obtained from the comparison between objective i and objective j for each individual. This square matrix has two fundamental properties: (a) all elements of its main diagonal take a value of one (a_{iik}=1 $\forall$ i), and (b) all other elements maintain that paired comparisons are reciprocal (if $a_{ijk}=x$ then $a_{jik}=1/x$). If perfect consistency in preferences holds for each decision-maker, it should also hold that $a_{ihk} \times a_{hjk} = a_{ijk}$ for all i, j and h. This condition implies that values given for paired comparisons represent weights given to each objective by a perfectly rational decision-maker $a_{ijk}= w_{ik}/w_{jk}$ for all i and j. Therefore, the Saaty matrix can also be expressed as follows:

$$A_k = \begin{bmatrix} \frac{w_{1k}}{w_{1k}} & \frac{w_{1k}}{w_{2k}} & \dots & \frac{w_{1k}}{w_{nk}} \\ \frac{w_{2k}}{w_{1k}} & \frac{w_{2k}}{w_{2k}} & \dots & \frac{w_{2k}}{w_{nk}} \\ \dots & \dots & \frac{w_{ik}}{w_{jk}} & \dots \\ \frac{w_{nk}}{w_{1k}} & \frac{w_{nk}}{w_{2k}} & \dots & \frac{w_{nk}}{w_{nk}} \end{bmatrix} \qquad (2)$$

Thus, if the decision-maker's property of perfect consistency holds, n weights (w_{ik}) for each objective can be easily determined from the $n(n\text{-}1)/2$ values for a_{ijk}. Unfortunately, perfect consistency is seldom present in reality, where personal subjectivity plays an important role in doing the paired comparison. For Saaty, matrices (A_k=a_{ijk}) in which some degree of inconsistency is present, alternative approaches have been proposed to estimate the weight vector that best resembles the decision-maker's real weight vector. Saaty (1980 and 2003) proposed two options as the best estimate of real weights: the geometric mean and the main eigenvector. Other authors have proposed alternatives based on regression analysis (Laininen and Hämäläinen, 2003) or goal programming (Bryson, 1995). No consensus has been reached regarding what alternative outperforms the others (Fichtner, 1986). As all criteria meet the requirements to estimate the above-mentioned weights, we choose the geometric mean (Aguarón and Moreno, 2000; Kallas *et al*., 2007). Using this approach, weights assigned by farmers to each objective are obtained using the following expression:

$$w_{ik} = \sqrt[n]{\prod_{i=1}^{i=n} a_{ijk}} \qquad \forall \ \text{i, k} \qquad (3)$$

Variables w_{ik} are used as covariates in the DA analysis. AHP was originally conceived for individual decision-making, but it was rapidly extended as a valid technique for the analysis of group decisions (Easley *et al*., 2000). To compare objective weights between organic and conventional farmers, group preferences must be considered. Thus, we need to aggregate the corresponding farmer's weights (w_{ik}) across farmers to obtain a synthesis of weights for each objective (w_i). The aggregation process should be carried out following Forman and Peniwati (1998), who consider that the most suitable method for aggregating individual weights (w_{ik}) in a social collective decision-making context is that of the geometric mean:

$$w_i = \sqrt[m]{\prod_{k=1}^{k=m} w_{ik}} \qquad \forall \ i \qquad (4)$$

where w_i is used to summarize the results of the AHP analysis.

4.2. The Duration Analysis (DA)

Duration analysis (DA) or duration modeling, as known in the economics field, models the time length of a spell or the duration of an episode or "*event*". The spell starts at the time of entry into a specific state and ends at a point when a new state is entered. As mentioned before, we apply DA to identify the determinants of adoption for organic practices and as well as the probability of a farm adopting organic practices at time *t*, given it has not been adopted by that time. We assume that the end of an event or the entering into a new state happens just once for each subject[1].

The conceptual foundations of DA rely on probability theory. Instead of focusing on the time length of a spell, one can consider the probability of its end or the probability of transition to a new state. To determine this probability, DA analysis uses the *hazard function* instead of the familiar probability distribution function.

Consider (T) as the random variable that measures the length of a spell. Also consider t as a realization of (T). Thus, the observed durations of each subject consist of a series of data $(t_1, t_2, \ldots t_n)$. Let $f(t)$ be a continuous probability distribution function (PDF) of the previously defined random variable (T). The probability distribution of the duration variable can be specified by the cumulative density function (CDF):

$$F(t) = \int_0^t f(s)\, ds = \Pr(T \le t) \qquad (5)$$

which indicates the probability of the random variable T being smaller than a certain value t. However, in duration analysis we are more interested in the probability that the spell has a length of at least t. This probability is given by the survivor function also known as the complementary cumulative distribution function (CCDF).

$$S(t) = 1 - F(t) = \int_t^\infty f(s) ds = \Pr(T > t) \qquad (6)$$

The probability of a duration end or a regime change in the next short interval of time Δt, given that the spell has lasted up to t is:

[1] When events happen more than once, a multilevel modeling for *recurring events* or *repeated events* should be applied (for more information see Box-Steffensmeier and Zorn, 2002 and Steele, 2008 among others).

$$\Pr\,(t \le T < t + \Delta t \,|\, T \ge t) \tag{7}$$

On the basis of this probability we define the hazard function or hazard rate that specifies the rate at which a spell is completed at time $T = t$, given it survives until time t. In other words, in our analysis, the hazard function represents the probability that a farmer adopts organic practices at time t, given he has not adopted before t:

$$\begin{aligned} h(t) &= \lim_{\Delta t \to 0} \frac{\Pr\,(t \le T < t + \Delta t \,|\, T \ge t)}{\Delta t} \\ &= \lim_{\Delta t \to 0} \frac{F(t+\Delta t) - F(t)}{\Delta t\; S(t)} \\ &= \frac{f(t)}{S(t)} \end{aligned} \tag{8}$$

Functions $f(t)$, $F(t)$, $S(t)$, and $h(t)$ are mathematically related as follows:

$$h(t) = \frac{f(t)}{S(t)} = \frac{(dF/dt)}{S(t)} = \frac{[d(1-S)/dt]}{S(t)} = \frac{(-dS/dt)}{S(t)} = -d \ln S(t)/dt \tag{9}$$

Besides the length of a spell, a set of explanatory variables of economic and non-economic nature may be expected to influence and alter the distribution of the duration. With the inclusion of additional explanatory variables in the DA, the hazard function needs to be redefined and re-formulated as being conditional on these variables (Lancaster, 1992):

$$h(t, \mathbf{x}, \boldsymbol{\theta}, \boldsymbol{\beta}) = \lim_{\Delta \to 0} \frac{\Pr\,(t \le T < t + \Delta \,|\, T \ge t)}{\Delta} \tag{10}$$

where $\boldsymbol{\beta}$ is a vector of unknown parameters of $\mathbf{x}$, the vector of explanatory variables which may include time invariant and time-varying variables and $\boldsymbol{\theta}$ is a vector of parameters that characterize the distribution function of the hazard rate.

After the inclusion of the explanatory variables, the hazard function $h(t, \mathbf{x}, \boldsymbol{\theta}, \boldsymbol{\beta})$ can be split into two components. The first component is the part of hazard that depends on subject characteristics $g(\mathbf{x}, \boldsymbol{\beta})$. The second one is the baseline hazard function $h_0(t)$ which is equal to the hazard when all covariates are zero and therefore it does not depend on individual characteristics. This component captures the way the hazard rate varies along duration.

To estimate the duration model we use the semiparametric *Cox proportional hazards model* (Cox, 1972). The Cox's semiparametric model has been widely used in the analysis of survival data to explain the effect of explanatory variables on hazard rates. Though the semiparametric model could potentially be less efficient than the parametric models in its use of the information provided by the data (D'Emden *et al.*, 2006), the loss of efficiency is likely to be quite small (Efron, 1977 and Lawless, 1982). Moreover, when using this model we can gain robustness in return (Allison, 1995), because the estimates have good properties regardless of the actual shape of the baseline hazard function. In this context, the advantage of a semiparametric model is that no assumptions need to be made about the shape of the hazard function.

Under the Cox proportional hazards model, the duration of each member of a population is assumed to follow its own hazard function $h_i(t)$ which can be expressed as:

$$h_i(t) = h\,(t; \mathbf{x}_i) = h_0(t)\,\exp(\mathbf{x}_i^{'}\boldsymbol{\beta}) = h_0(t)\,\exp(\beta_1 x_{i1} + \cdots + \beta_k x_{ik})\,, \tag{11}$$

thus,

$$\log h_i(t) = \alpha(t) + \beta_1 x_{i1} + \cdots + \beta_k x_{ik} \tag{12}$$

where $h_0(t)$ is an arbitrary and unspecified baseline hazard function, except that it can't be negative and $\alpha(t) = \log h_0(t)$. The $\boldsymbol{\beta}$ coefficients can be interpreted as the constant proportional effect of $\mathbf{x}$ on the conditional probability of completing a spell. The property that individuals in the sample display proportional hazard functions is met because the ratio $\frac{h_i(t)}{h_j(t)} = \exp\left\{\beta_1(x_{i1} - x_{j1}) + \cdots + \beta_k(x_{ik} - x_{jk})\right\}$ of two subjects i and j is constant over time t, since $h_0(t)$ cancels out.

The estimation procedure is based on the partial likelihood function introduced by Cox (1972, 1975), which eliminates the unknown baseline hazard $h_0(t)$ and thus discards the portion of the likelihood function that contains information on the dependence of the hazard on time. Moreover, this partial function does account for censored duration. Considering the duration for each subject i, t_i, $i = 1...n$, the partial log-likelihood function can be expressed as:

$$PL = \prod_{i=1}^{n} \left[\frac{e^{\beta x_i}}{\sum_{j=1}^{n} Y_{ij} e^{\beta x_j}} \right]^{\delta_i} \tag{13}$$

Where, δ_i is an indicator variable with a value of 1 if t_i is uncensored or a value of 0 if t_i is censored. Y_{ij} has a value of 1 if $t_j \geq t_i$ and $Y_{ij} = 0$ if $t_j < t_i$. The optimization problem to maximize the partial likelihood function can be expressed as:

$$Log\ PL = \max_{\beta} \sum_{i=1}^{n} \delta_i \left[\beta x_i - \log\left(\sum_{j=1}^{n} Y_{ij} e^{\beta x_j} \right) \right] \tag{14}$$

5. Empirical application

Data used in this analysis were obtained from face-to-face questionnaires with farmers carried out during March-June 2008 in the major organic grape-growing areas in Catalonia. The choice of these areas was based on the list of certified organic farmers obtained from the official certification organism in Catalonia (CCPAE). Following previous research, neighboring conventional farms were also chosen so that the two subsamples would have an analogous composition (Tzouvelekas *et al.*, 2001). Specifically, for each organic farm, we selected at least three conventional farms located in the same area. The final sample consists of 26 organic and 94 conventional farms.

The survey collects extensive information on farmer's characteristics, attitudes and opinions, farm physical and economic characteristics and on the determinants of adoption of organic practices. Information collected on farmer and household characteristics (F_i) includes age, gender, education, whether other household members have a university degree, number of family members, or nearness of family and friends to farmer residence. Information gathered on farm characteristics (S_i) consists of farm size, ownership of the farm, distance between farm and farmer residence, UAA, whether the farm is located in a disfavoured area according to the CAP, farm altitude, number of plots in the farm, water availability, soil quality, or number of organic farms within a 10 km radius. Variables reflecting farm management and results (M_i) are: preferred sources of information on agricultural practices, number of soil analyses per year, proportion of rented land, number of cultivated grape varieties, proportion of irrigated land, percentage of total family income coming from agriculture, internet and e-mail use, accounting software use, percentage of sales to conventional wholesalers and/or processors, family labour, number of generations working in the farm, paid Annual Working Units (AWU), income per hectare, or total cost per hectare. Exogenous factors $\left(E_i\right)$ include, among others, availability of information sources, difficulties in obtaining information, problems in getting loans, output prices, or public subsidies.

Information on attitudes and opinions $\left(A_i\right)$ were collected by presenting farmers with a series of different statements about organic practices, environment, and other general questions. On a Likert scale from 0 to 10, farmers were asked how much they agreed with different statements on risk attitudes, the use of dangerous and chemical inputs, regulatory issues, the perception of economic agents toward organic farming, farmers' incentives to convert and farmer's opinions toward organic farming. Since extensive information on this issue was gathered and as noted above, the available information was reduced to lower dimensions using PCA. The resulting factors were used in a subsequent step as independent variables in the DA.

Information on farmers' objectives[2] $\left(O_i\right)$ was collected by asking farmers to make a paired comparison of different objectives using a 1 to 9 scale. As noted, three primary objectives were considered in the comparison: economic, environmental and socio-cultural. Within each primary objective, farmers were also asked to compare three secondary objectives in a pair wise nature. Secondary economic objectives were: "maximize vineyard sales", "maximize total farm income from agricultural and non-agricultural activities" and "maximize profits". The environmental secondary objectives included: "promoting environmentally friendly farming practices", "maintain soil fertility" and "rational use of water". The secondary socio-cultural objectives were: "generate employment in the farmer area", "keep the existing socio-cultural values" and "prevent the depopulation of rural areas". From the results, we identified the relative weights of each objective that were then used as covariates in the DA.

Apart from the information collected in the survey, other time-variant variables were also considered in the DA, in order to capture systematic changes in the economic conditions and farmers' characteristics that could affect their decision to adopt (Burton *et al.*, 2003 and Allison, 1995). We used several dummy variables representing policy changes which include a dummy taking the value of one on and after the year 1991, when regulation 2078/91 was passed, and zero otherwise. Another dummy variable representing the period from the creation of the official certification organism in Catalonia in 1995 and onwards, was also defined. In addition, a dummy variable was used to distinguish between the post and pre Regulation 1257/1999 period. Finally, a dummy variable was considered to capture the impact of the creation of the logotype "organic agriculture- control system" in 2001. Furthermore, several calendar year time trend covariates were considered (Burton *et al.*, 2003). The first one takes a value of -31 in 1961 (first year "at risk", i.e. first entry date in our sample), with an increment of one until 1991. The second one takes a value of -35 in 1961, with an increment of one until 1995. The last trend takes a value of -39 in 1961, with increment of one until 1999.

The dependent variable used in the DA is the time farmers waited before adopting organic farming. As Kiefer (1988) mentions, DA requires a precise beginning time to compute the duration. In our case, it was set as the date when the farmer started to manage holding[3]. It is also necessary to define a time scale which is "years" in our case, as well as the event ending duration (the year when the farmer adopts organic practices). Because not all farmers had adopted organic farming by the time of carrying out the survey, a right censoring characterizes our data. Further, as mentioned before, the data suffer from the random censoring characteristic. This characteristic is due to different entry times (the year when the farmer started managing the farm), that vary randomly across farmers. As Allison (1995) recommends, an easy solution to random censoring is to include the entry time as a covariate in the regression.

[2] Primary and secondary objectives were defined in two different focus groups, The first was integrated by university faculty in the field of agricultural economics, and the second was composed by policy makers and leaders of agricultural associations.
[3] This decision was taken because organic farming has always been "available" to farms (Burton *et al.,* 2003).

6. Results

As a result of the PCA application to measure farmers' attitudes and opinions, several factors were obtained. The first PCA was applied to the variables measuring the perception by the farmer of the attitudes of society toward organic farming. The resulting relevant factors are: "perception by commercial agents" (a_1) and "perception by social agents" (a_2) (see Table 3). The second PCA was applied to farmers' incentives to convert to organic farming. The derived factors are: "National and international perspectives" (a_3), "economic motivations" (a_4) and "personal motivations" (a_5). The third PCA was applied to farmers' own opinions toward organic farming with "quality and image" (a_6) and "future viability" (a_7) as relevant factors.

Table 3: Results from Principal Component Analysis (PCA) on farmers' attitudes and opinions

Perception of the attitudes of different economic agents toward organic farming

Variables	**Factor 1** (a_1) Commercial agents	**Factor 2** (a_2) Social agents
Consumers	***.761***	.033
Retailers	***.697***	.139
Banks	***.643***	.137
Farmers in your area	***.584***	.140
Labor unions	.191	***.820***
Membership of a producer organization	.058	***.758***
Family members	.138	***.659***
Cronbach' Alfa: 0.68 / KMO: 0.68 / Bartrlet Test: 120.17 (0.000) / Explained variance: 51.7% / Rotation method: Varimax		

Farmers' incentives to conversion to organic farming

Variables	**Factor 1** (a_3) National and international perspectives	**Factor 2** (a_4) Economic motivations	**Factor 3** (a_5) Personal motivations
There are positive perspectives in international markets	***.822***	.038	.171
There are positive perspectives in national markets	***.739***	.090	.163
Conversion allow to access to economic support	.201	**.844**	-.093
Inputs in conventional agriculture are more expensive	-.222	**.722**	.457
Diversification of the distribution channels	.446	**.480**	.030
Adoption prevents family health problems from chemicals	.121	.015	**.847**
Adoption brings personal satisfaction	.185	.056	**.553**
Cronbach' Alfa: 0.623 / KMO: 0.60 / Bartrlet Test: 94.82 (0.000) / Explained variance: 61.9% / Rotation method: Varimax			

Farmers' opinions toward organic farming

Variables	**Factor 1** (a_6) **Quality and image**	**Factor 2** (a_7) **Future viability**
Organic farming improves soil fertility and its structure	**.767**	.213
Organic products have better quality than conventional ones	**.635**	.156
Organic farming gives a positive image to the farm	**.570**	.106
Organic products are more healthy than conventional ones	**.380**	-.012
Organic price premiums compensate for increased production costs	.183	**.809**
Organic farming helps to ensure farm's economic viability	.409	**.750**
Organic farming has more risk due to yield fluctuation	.433	**-.565**
The management of organic farming is more flexible than the management of conventional farming	.076	**.485**
Cronbach' Alfa: 0.593 / KMO: 0.65 / Bartrlet Test: 152.19 (0.000) / Explained variance: 46.33% / Rotation method: Varimax		

As noted above, the AHP allows obtaining the weights assigned by each individual to the primary and secondary objectives using the geometric mean criteria. The results of the aggregation of the weights for the three primary objectives (wo_1, wo_2 and wo_3) across farmers are shown in Table 4.

Table 4: Aggregated weights for organic and conventional farmers' objectives

	Economic objectives wo_1		**Environmental objectives wo_2**		**Socio-cultural objectives wo_3**	
	Conv.	**Org.**	**Conv.**	**Org.**	**Conv.**	**Org.**
Aggregated weight (geometric mean)	**0.623**	**0.428**	**0.241**	**0.391**	**0.136**	**0.181**
Arithmetic mean	0.589	0.416	0.243	0.384	0.160	0.200
Trimmed mean*	0.691	0.333	0.205	0.333	0.111	0.177
Variance	0.043	0.029	0.017	0.022	0.023	0.013
Median	0.644	0.418	0.249	0.335	0.107	0.167

* Computed discarding the 25% lowest scores and the 25% highest ones.

These results suggest that for conventional farmers the economic objective is the most important with an aggregate weight (wo_1) of 62.3%. Environmental (wo_2) and socio-cultural (wo_3) objectives occupy the second and third positions with aggregate weights of 24.1% and 13.6%, respectively. This hierarchy is also applicable to the organic group, but environmental and socio-cultural objectives have a higher relative relevance to the detriment of the economic objective.

Results from weighting the secondary objectives are summarized in Figure 2. As can be seen, there are differences in relative weights between conventional and organic farmers. It is worth mentioning that while organic farmers are more interested in promoting practices that do not harm the environment, conventional farmers give more importance to water and soil quality. From these results we derive the proportions of the relative weights within the primary and secondary objective groups for each individual (see Table 5 for summary statistics). As explained, these proportions are used in a posterior step as independent variables in the DA.

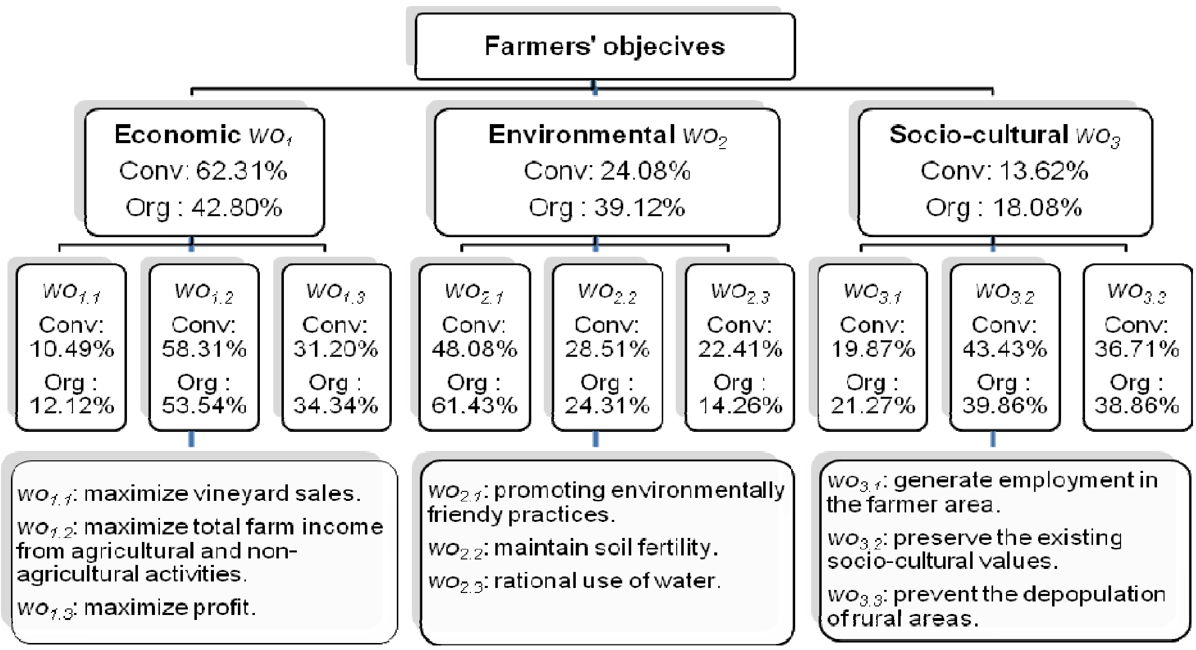

Figure 2: Results of the Hierarchical structure of conventional and organic farmers' objectives

Table 5: Proportions of the relative weights of primary and secondary included in the DA model

Variable	***Description***	***Mean*** **Organic**	***St. Dev***	***Mean*** **Conventional**	***St. Dev***
	Farmer primary objectives				
wo_2 / wo_1	Relative weight between “environmental” and “economic” objectives	3.77	4.32	7.35	5.61
wo_1 / wo_3	Relative weight between “economic” and “socio-cultural” objectives	1.49	1.75	5.87	22.52
wo_2 / wo_3	Relative weight between “environmental” and “socio-cultural” objectives	0.58	0.38	0.96	1.38
	Economic secondary objectives				
$wo_{1.1} / wo_{1.2}$	Relative weight between “maximize vineyard sales” and “maximize total farm income from agricultural and non-agricultural activities”	0.80	2.02	0.61	1.23
$wo_{1.1} / wo_{1.3}$	Relative weight between “maximize vineyard sales” and “maximize profits”	0.55	0.67	1.02	3.24
$wo_{1.2} / wo_{1.3}$	Relative weight between “maximize total farm income from agricultural and non-agricultural activities” and “maximize profit”	2.79	2.55	3.04	2.52
	Environmental secondary objectives				
$wo_{2.1} / wo_{2.2}$	Relative weight between “promoting environmentally friendly farming practices” and “maintain soil fertility”	1.19	1.89	1.29	3.05
$wo_{2.1} / wo_{2.3}$	Relative weight between “promoting environmentally friendly farming practices” and “rational use of water”	1.15	1.27	1.23	1.96
$wo_{1.2} / wo_{1.3}$	Relative weight between “maintain soil fertility” and “rational use of water”	2.06	2.87	2.40	2.90
	Socio-cultural secondary objectives				
$wo_{3.1} / wo_{3.2}$	Relative weight between “generate employment in the farmer area” and “keep the existing socio-cultural values”	3.11	2.02	2.74	2.97
$wo_{3.1} / wo_{3.3}$	Relative weight between “generate employment in the farmer area” and “prevent the depopulation of rural areas”	7.33	6.34	4.6	4.7
$wo_{3.2} / wo_{3.3}$	Relative weight between “keep the existing socio-cultural values” and “prevent the depopulation of rural areas”	2.74	2.38	2.94	3.70

Different DA models were estimated using different combinations of the variables available from the survey. We followed the forward stepwise method to determine the final list of variables to include in the model. Summary statistics of these explanatory variables for both types of farmers are shown in Appendix 1. The resulting model is presented in Table 6. At a 95% confidence level, we can reject the null hypothesis that all coefficients are jointly equal to zero.

The presence of a local authority serving as a source of information is found to increase the hazard function, which involves a reduction in the time needed to convert. This result is in accordance with the findings of Rigby *et al*. (2001), Padel, (2001) and Parra and Calatrava (2005) who conclude that the availability of information sources is an important factor in explaining conversion. Results also suggest that farmers that are not risk averse are more prone to adopt organic farming, confirming the findings by De Cock (2005) who states that conventional farmers usually pay more attention to risk than organic farmers. Compatible with these results, Serra *et al*. (2008) and Gardebroek (2006) find that organic farmers are less risk averse than their conventional counterparts. Our results also show that difficulties in getting loans increase adoption. This result could be explained by the fact that adopters are mainly small family farms that usually display more conservative leverage levels and have more problems in getting loans than their conventional counterparts. The finding that credit restrictions reduce adoption is in contrast with the results obtained by Padel (2001) and Rigby *et al*. (2001) who find that refusal of loans and insurance is one of the most important institutional barriers to adoption.

As expected, we find that the location of farms in a disfavored area, which usually involves the presence of some management difficulties, motivates adoption. This is in accord with the results by Padel and Lampkin (1994), Padel (2001) and Rigby and Young (2000). Farmers who have a second economic activity, apart from agriculture, are more likely to convert. Also, farmers whose total farm income is only coming from viticulture are less prone to convert. These results are in line with those obtained by Peters (1994), Padel (2001) and Hanson *et al*. (2004) who found that diversification of production may play an important role in increasing the probability of conversion. These results are also compatible with the fact that organic farms usually diversify their activities, which reduces the risk derived from possible yield losses. Farmers whose decision to adopt is mainly based on commercial reasons are found to have a lower hazard.

Table 6: Results from partial likelihood estimation for COX proportional Hazard model

Variable	Parameter	Std. Error	*P*-value	Hazard Ratio
Relative weight between “environmental” and “economic” objectives	0.721**	0.315	0.022	2.056
Relative weight between “promoting environmentally friendly farming practices” and “rational use of water”	0.235***	0.078	0.003	1.265
Relative weight between “generate employment in the farmer area” and “prevent the depopulation of rural areas”	0.683***	0.249	0.006	1.981
Age at conversion	-0.279***	0.062	0.000	0.757
Year when management responsibility was assumed	0.127**	0.050	0.011	1.135
If farmer has a secondary activity = 1; 0 = otherwise	2.548**	0.924	0.006	12.785
Percentage of total farm income coming from viticulture	-0.028*	0.016	0.085	0.973
Total farm size	-0.083***	0.029	0.005	0.921
Disfavoured area according to the CAP = 1, 0 = otherwise	1.516**	0.718	0.035	4.556
Local agricultural authorities as information source = 1; 0 = otherwise	4.442***	1.372	0.001	84.932
Difficulties in getting loans, Likert scale > 6 = 1; 0= otherwise	2.773**	1.226	0.024	16.007
Price of grape for white wine €/kg.	0.900***	0.306	0.003	2.459
Dummy variable for 2001 = 1, 0 prior to 2001.	4.298***	1.606	0.007	73.533
Risk attitude, Likert scale > 6 = 1; 0 = otherwise	2.318**	0.983	0.018	10.155
Opinion on banning dangerous inputs, Likert scale > 6 =1; 0= otherwise	2.325***	0.854	0.007	10.225
PCA results: Positive perception of “Social agents” toward organic farming	1.124**	0.513	0.028	3.078
PCA Results: economic motivations to convert	-1.424***	0.440	0.001	0.241
PCA results: Quality and positive image of organic products	1.553***	0.508	0.002	4.723
Likelihood Ratio: 124.115 (0.000) / Wald test: 35.433 (0.012) / Lagrange Multiplier Test: 96.371 (0.000)				

Significance levels: ***p < 0.01; **p < 0.05; *p < 0.10.

Results suggest also that farmers with positive attitudes and opinions toward organic farming have a shorter duration. Those who believe in a positive perception of social agents towards organic agriculture, agree that dangerous chemical inputs should be prohibited and consider that organic products are of high quality, have a higher hazard to convert. Rigby *et al*. (2001) and Parra and Calatrava (2005) also found that positive attitudes positively influence the decision to adopt.

Other obtained results are also as expected. Compatible with Padel (2001), Rigby and Young (2000) and Anderson *et al*. (2005), older farmers are found to be less likely to adopt. Farmers who have recently undertaken the management of the farm have a higher hazard to convert. Moreover, in accordance with other studies (Lockeretz, 1995; Lipson, 1999; Burton *et al*., 1999; Padel, 2001, and Hattam and Holloway, 2004), organic holdings tend to be smaller than conventional farms. Thus, large farms have a lower hazard and thus a higher duration-time. It is also worth mentioning that an increase in white wine prices increases the hazard which, consistent with Rigby and Young (2000), Burton *et al*. (2001) and De Cock (2005), suggests the relevance of economic determinants when explaining adoption. Furthermore, white wine represents 70% of the total wine produced in Catalonia (mainly sold as sparkling wine) and is one of the most popular exports from the region (MARM, 2007). This explains the relevance of white wine prices among the determinants of adoption.

Most of the dummy variables representing policy changes are not statistically significant, with the exception being the dummy variable representing the year 2001. This specific year has a significant positive impact on the decision to convert suggesting that the introduction of the organic farming logotype motivated further conversion.

Our results suggest that the importance of the environmental over the economic considerations is a basic factor in the decision to adopt. Thus, an increase in the weight of the environmental objectives over the weight of the economic objectives leads to an increase in the hazard. Further, an increase in the weight that farmers attribute to adopting “farming practices which are respectful with the environment” to the detriment of a “rational use of water” decreases the waiting time to convert. Moreover, an increase in the importance of the objective “generate employment in the farmer area” over the objective “preventing the depopulation of rural areas” increases the probability to convert in a shorter time. These results suggest that both the commitment of organic farmers to the preservation of the environment and the generation of economic activity are important determinants to conversion. Previous empirical analyses have shown that organic farming is more labour demanding than conventional agriculture (OECD, 2000). In this line, our results demonstrate that the aspect of generating employment is an important factor for conversion and highlights the social role of the vineyard organic agriculture in Catalonia.

7. Conclusions

Our paper focuses on assessing the determinants of organic farming adoption as well the timing of the conversion decision. We carry out an empirical analysis using the Duration Analysis (DA) due to its potential to analyze both the decision and diffusion aspects of organic farming adoption. The model is estimated using farm-level data from a sample of both organic and conventional Catalan farms specialized in grape production. Data were collected though a questionnaire carried out in 2008.

The dependent variable used in the DA is the time farmers waited before adopting organic farming as measured by the number of years after the farmers were responsible for farm management. Several explanatory variables were considered representing farmer and farm characteristics, farm management and results, exogenous factors, attitudes and opinions and farmers’ objectives. We used the Analytical Hierarchy Process (AHP) to measure farmers’ objectives and the Principal Components Analysis (PCA) to synthesize information on farmers’ attitudes and opinions.

Several variables are found to increase the hazard of adoption. Farmers who have recently undertaken the management of the farm, who are risk loving, are willing to preserve the environment and generate employment in their area, are more prone to adopt in a shorter period of time. Small farms that are located in less favored areas and that diversify their production also display higher hazard rates. Farmers receiving higher output prices, who have difficulties in accessing credit and that have a second economic activity besides farming, are more likely to adopt as well. Finally, easy access to information sources, the presence of local agricultural authorities and some policy regulations also motivate higher adoption rates. On the other hand, older farmers whose decisions are mainly based on economic variables and who are running very specialized and big farms, have a low hazard to adopt organic practices.

Our analysis is based on a semi-parametric approach that still requires the parameterization of the risk function. Misspecification of this function will lead to inconsistent results. Our results should thus be interpreted carefully. To overcome this limitation, the literature on the topic has recently proposed the use of local estimation techniques. It would thus be interesting to compare our results with the ones derived from this alternative approach. This task is however beyond the scope of the paper and is proposed for future research.

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Appendix 1: Variables included in the DA model

Variable	Description		Organic Mean	Organic St. Dev	Conventional Mean	Conventional St. Dev
Farmer characteristics F_i						
f_1	Time-varying variable: Age when farmer decides to convert		36.52	9.92	43.75	11.10
f_2	Time-varying variable: Year when the farm management was undertaken		1993.9	8.12	1989.7	11.1
f_3	If farmer has a secondary economic activity=1; 0 = otherwise		0.65	0.48	0.47	0.50
Farm characteristics S_i						
s_1	Total farm size: in hectares.		17.96	12.8	49.07	82.39
s_2	Disfavoured area according to the CAP=1, 0= otherwise		0.53	0.50	0.28	0.45
Farm management and results M_i						
m_1	Viticulture income as a percentage of total farm income		72.19	29.76	70.11	27.26
Exogenous factors E_i						
e_1	Information source:	$e_{1.1}$ Input suppliers = 1; 0= otherwise	0.57	0.50	0.78	0.41
		$e_{1.2}$ Cooperatives or processors = 1; 0= otherwise	0.34	0.48	0.24	0.43
		$e_{1.3}$ local agricultural authorities = 1; 0= otherwise	0.65	0.48	0.53	0.50
		$e_{1.4}$ Specialized literature= 1; 0= otherwise	0.76	0.42	0.56	0.49
e_2	Problems in getting loans (0= easy to 10= difficult)	$e_{2.1}$ (difficulty scale < 4) = base level	-	-	-	-
		$e_{2.2}$ (4 ≤ difficulty scale ≤ 6) =1; 0= otherwise	0.30	0.47	0.51	0.50
		$e_{2.3}$ (difficulty scale > 6) =1; 0= otherwise	0.07	0.27	0.17	0.37
e_3	Price of grape for white wine €/kg		0.55	1.21	0.26	0.19
e_4	Dummy variable for 2001>=1 (0 before 2001) to capture the impact of the introduction of logotype "organic agriculture- control system"					
Attitudes and opinions (A_i)						
PCA results on the perception of economic agents toward organic farming		a_2 Social Agents	0.83	0.98	-0.23	0.87
PCA results on farmer's incentives to convert to organic farming		a_4 Economic motivations	-0.71	1.20	0.19	0.84
PCA results on farmer's opinions toward organic farming		a_6 Quality and image	0.76	0.85	-0.21	0.93
a_7	Risk attitude in a scale from 0= risk averse to 10= risk loving	$a_{7.0}$ (risk attitude scale < 4) = base level	-	-	-	-
		$a_{7.1}$ (4≤ risk attitude scale ≤ 6) = 1; 0= otherwise	0.42	0.50	0.35	0.47
		$a_{7.2}$ (risk attitude scale > 6) = 1; 0= otherwise	0.46	0.50	0.51	0.50
a_8	Dangerous inputs should be prohibited (0= disagree to 10= agree)	$a_{8.0}$ (banning attitude scale < 4) = base level	-	-	-	-
		$a_{8.1}$ (4≤ banning attitude scale ≤ 6) =1; 0= otherwise	0.07	0.27	0.31	0.46
		$a_{8.2}$ (banning attitude scale > 6) =1; 0= otherwise	0.88	0.32	0.55	0.49