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A choice model-based analysis of diversification in organic and conventional farms

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Abstract. Diversification is a polymorphic strategy to increase agricultural income and reduce the risks deriving from the surrounding environment. This strategy can also be successfully adopted in the context of organic farming. However, there is a lack of confirmation in this regard given the scarcity of studies that explicitly focus on diversification in organic farms. The objective of this paper is to analyse the influence of some territorial, socio-economic, and political factors on the probability of diversifying in both organic and conventional farms. To this aim, multinomial and binary logit models are applied to the Italian case. Results suggest that on-farm diversification requires specific competences and adequate organization. However, the reasons for diversifying differ depending on the production model. In conventional farming, farmers diversify to achieve income levels comparable with those of a more competitive agriculture. Conversely, for organic farmers, diversification represents an integrated part of the production model to take advantage of synergies between organic production and diversification. From these results, some policy implications are drawn.

Keywords: on-farm diversification, Common Agricultural Policy, organic farming, conventional farming, multinomial logit model.
JEL Codes: C25, Q12, Q18.

1. INTRODUCTION

Farmers can use different strategies to increase and stabilize income and reduce the risks deriving from external pressures and changes in the socio-economic context. As a prevention strategy, they can diversify their sources of income to spread the risk over more activities (Salvioni *et al.*, 2020). Diversification is a polymorphic strategy that can be expressed both inside and outside the farm through several multifunctional directions which can be broadly classified as deepening, broadening and re-grounding (van der Ploeg and Roep, 2003). It involves that one or more farm inputs are partially diverted from agricultural production: (a) within the same agri-food chain, to expand products range, quality and value or to shorten the length of the supply chain (deepening); (b) to produce other types of goods and services, such as hospitality, restoration, welfare and environmental services (broadening); (c) outside the primary sector, to integrate agricultural income (re-grounding).

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The potential of diversification is recognized both for farms, especially for family ones, and for rural areas, as evidenced by the specific support granted at the European level by the Common Agricultural Policy (CAP), specifically the Rural Development Policy (RDP) (European Parliament, 2016). This strategy not only can be successfully adopted in the context of organic farming but might also provide a comparative advantage over conventional farms that diversify by leveraging the willingness of consumers to pay higher prices for products and services provided by organic farms. However, there is a lack of confirmation in this regard given the scarcity of studies that explicitly focus on diversification in organic farms. This is because, in the wide stream of literature on multifunctionality and diversification, organic farming is commonly considered as a deepening strategy of conventional farms and is analysed as one of the factors explaining diversification (Salvioni *et al.*, 2009; Rivaroli *et al.*, 2017; Dries *et al.*, 2012). Nevertheless, organic farming is a specific farm model, which brings about a rethinking of the management of the whole farm and its relations with the "outside world", inspired by principles of sustainability (Luttikholt, 2007). Chemically synthesised inputs are strictly limited and replaced with inputs of natural origin. Furthermore, techniques that prevent pollution, improve product quality, increase animal welfare standards, and ensure a soil ecology that retains nutrients and biodiversity are introduced. In this way, organic farming carries out a dual and complex function related to both the market and the production of public goods, in accordance with the changing consumers' preferences (Regulation EC No 2018/848). This change is also reflected in the growth and in spread of organic farming. Focusing on the European Union context, according to Eurostat statistics, from 2012 to 2019, organic area, including that under conversion, increased by 46%, reaching a share of around 9% of 2016 total utilised agricultural area. Italy, with 16% of organic area, is among the countries with the highest share of agricultural area devoted to organic production and with the highest growth rate (+70%). For all these reasons, organic farming cannot be considered as a mere option of diversification, but a unique model of production as opposed to the dominant model of conventional agriculture, which is taking increasing importance especially in some European countries such as Italy.

There is a wide literature analysing the determinants and the theoretical foundations of the process of income diversification (Boncinelli *et al.*, 2018). However, to the authors' knowledge, there is no research work that focuses on the differences between organic and conventional farmers concerning the reasons that lead to diversification. The knowledge of factors affecting the choice of diversification in different farm models can be helpful for two main reasons. Firstly, it contributes to verifying the hypothesis that the decision of diversifying is a necessity related to income volatility and lower levels of competitiveness, which push farmers to seek alternative opportunities to traditional activities in order to increase and stabilize income. In this respect, it may help policy makers to better define policy instruments. If the reasons explaining diversification vary according to the type of farms, policies can be usefully differentiated and better targeted, therefore increasing their effectiveness. Secondly, it can contribute to better assessing policy effectiveness. In fact, a certain sensitivity of farmers to policy support can be a signal of effectiveness of policy instruments in favour of diversification. However, if this were confirmed also for organic farms, i.e., organic farms diversify thanks to the support to diversification, there could be indirect implications related to the effectiveness of policy supporting organic farming, which could be further investigated. This policy is aimed at incentivising organic farming by payments that should cover the higher costs that the adoption of organic practices brings about in comparison with conventional farming. In consideration of the higher prices paid by consumers for organic products, hence the potentially higher revenues for organic farms, if farms, which benefit from policy support for adopting organic practices, diversify by using support for diversification, this could mean that the payments aimed at encouraging organic farming are not sufficient to cover the higher costs, thus forcing organic farms to diversify by activating the related policy tools.

The objective of this paper is to assess the differences between organic and conventional farmers in the choice of on-farm diversification. More precisely, the aim is to analyse the influence of territorial, socio-economic, and political factors on the probability of diversifying in these two types of farmers. The main novelty lies in an unconventional approach to diversification where organic farming is not analysed as a mere strategy of diversification but as a distinct entrepreneurial model that may have different motivations leading to a differentiated policy approach.

For the purposes of this study, logit models are adopted. Logistic regression analysis is widely used in several disciplines to investigate the relationship between binary or ordinal response probability and explanatory variables. Multinomial logistic regression generalizes logistic regression to problems with more than two possible discrete outcomes. This kind of models have been already applied to study the phenomenon of diversification in agriculture (i.e., Meraner *et al.*, 2015; Vik and Mcelwee, 2011). A multinomial logit model is first applied to compare organic and conventional farmers who diversify with farmers with no diversification strategies. This model gives the possibility of directly comparing two distinct groups of farmers relative to a base group. A logistic model is then applied only to farmers who diversify, in order to investigate the effects of specific factors affecting diversification, particularly policies in favour of diversification. This analysis is carried out by using the Farm Accountancy Data Network (FADN) sample of Italian farmers for the period 2014-2018.

The remaining of this paper is organized as follows. Section 2 provides an overview of the existing literature on the main determinants of on-farm diversification and on the potential synergies deriving from combining organic production with diversification. Section 3 illustrates the methodology, the variables and the data used. Sections 4 and 5 present and discuss the results of this analysis, respectively. Section 6 provides some concluding remarks and policy implications.

2. ON-FARM DIVERSIFICATION AND ORGANIC FARMING

On-farm income diversification in agriculture roots in the multifunctional role of agriculture (Henke and Vanni, 2017; Meraner *et al*., 2015; Van Huylenbroeck *et al*., 2007). Brought in vogue at the time of Agenda 2000 to legitimate the public support to the European model of agriculture, multifunctionality has become the key to a renovated role of agriculture and rural areas in the European and other developed contexts. On-farm diversification is practical application of multifunctionality through which new functions of production in agriculture complement, and sometimes compete with, the main one related to food production, especially in terms of inputs such as land, family labour and capital. Deep and ongoing environmental and economic changes have enhanced the interest in on-farm diversification, by reallocating production factors towards new non-agricultural activities.

The reasons that lead farmers to diversify have been widely investigated in literature. Traditionally, economic survival and occupation strategies have been the main drivers of off-farm diversification. However, in on-farm diversification, several factors play a role in the decision to diversify. Most are related to farmer characteristics, such as level of education (McElwee and Bosworth, 2010; Boncinelli *et al*., 2017,2018; Khanal, 2020) and age (Barbieri and Mahoney, 2009; Joo *et al*., 2013; Boncinelli *et al*., 2018; Meraner *et al*., 2015); farm characteristics, such as farm size (McNamara and Weiss, 2005; Ilbery, 1991; McNally, 2001; García-Arias *et al*., 2015; Bartolini *et al*., 2014; Boncinelli *et al*., 2018; Dries *et al*., 2012), productive specialization and location (Dries *et al*., 2012; Bartolini *et al*., 2014; Rivaroli *et al*., 2017); and policy support (Bartolini *et al*., 2014). However, studies do not always reach unanimous conclusions on the factors that affect farm diversification and how they act. For instance, Joo *et al*. (2013) show that older farmers are more likely to participate in agritourism while Barbieri and Mahoney (2009) suggest that young farmers have a longer-term view that pushes them to diversify. According to Boncinelli *et al*. (2018), younger and older farmers have the same behaviour in relation to diversification. It is also interesting to find different results about policy in literature despite the existence of rural development instruments specifically conceived to support farm diversification. While, for some studies, policy is ineffective or produces weak effects (Boncinelli *et al*., 2017,2018), for others, both CAP Pillars positively influence farm diversification (Bartolini *et al*., 2014).

A reason that could explain contrasting results is that research on diversification mostly analyses organic and conventional farms jointly and considers organic farming as a strategy of on-farm diversification. This type of analysis is founded on the idea that organic production is a secondary function that farms introduce to expand their business portfolio, as they do when they decide to process products and sell them directly. This approach can be valid if farms implement the organic method only on a part of total production, but it is less appropriate where this choice, which involves an increasing number of farms, concerns the whole farm.

As a consequence, studies that specifically analyse diversification in organic farms are fewer, even though results highlight the relevance of such a combination. Frederiksen and Langer (2008) show that half of Danish organic farms engage in other farm-based activities, especially direct sales, of which a half is of some or major economic importance. They conclude that on-farm diversification should not be simply considered as a pathway away from agriculture but an integrated part of organic farming strategies. David *et al*. (2010) investigate the adaptive capacity of organic farms that adopt diversification strategies. They analyse the evolution of some organic farms in the southeast of France over a 15-year period, monitoring farm performance and farmers' strategy. Their results show that on and off-farm diversification contribute significantly to farm viability. Aubert and Enjolras (2016), using an econometric model with simultaneous equations based on data from the 2010 census of French farms, demonstrate that farmers specialised in winegrowing and arboriculture who adopt organic farming label are more likely to sell their produce through short food supply chains. As for the Italian context, the choice to diversify appears more relevant in the organic sector than in the entire agricultural sector. For instance, Dries *et al.* (2012), by a multivariate probit model applied to 2006 data from Italian FADN, demonstrate that there is complementarity between agricultural diversification activities, such as organic farming, and the structural ones, such as direct sales or agritourism. Bartolini *et al.* (2014) show a greater probability of diversification for cases of organic management in the Tuscany region, due to the synergies between different diversification strategies. Marongiu and Cesaro (2017), by applying a logistic regression model to the Italian FADN data for the period 2013-2015, reveal the existence of a positive correlation between participation in food quality systems, such as organic farming, and the presence of related activities in farms specialized in permanent crops and dairy production. Khanal *et al.* (2019) confirm the existence of correlations between agritourism and organic diversification strategies for US farmers due to possible synergies between them and warn that the estimates produced by choice models could be biased if these correlations were not taken into account. By analysing the willingness to pay for a designated farm holiday stay in an Italian region of Trentino Alto-Adige, Sidali *et al*., (2019) show that this complementarity also gives a comparative advantage in that the combination of organic farming and farm stay operations ensures a higher accommodation price than what conventional farms offering only hospitality are able to obtain.

The studies that specifically analyse the determinants of diversification in organic farmers are even fewer. Zander (2008), based on a survey conducted on a sample of successful organic farms in Germany, concludes that an important motivation for organic farmers to opt for the vertical integration is to keep the value added of their products on farm. Moreover, they give evidence that farmers who diversify tend to be larger in order to achieve good market conditions and that the availability of high skills is a precondition for successful diversification. Weltin *et al.* (2017) use a survey of over 2 thousand farms from eleven European regions in order to investigate differences regarding the willingness to diversify in the future. They find that farm households with organic production led by young farmers are most likely to diversify activities, particularly on-farm.

3. MATERIALS AND METHODS

3.1 The model

The model used is a multinomial logit model where a farmer makes a choice among three unordered alternatives: 1) no diversification; 2) conventional production and diversification; 3) organic production and diversification. Farmer *i*'s utility derived from choice alternative *j* is:

$$U_{ij} = \mathbf{x}'_i\boldsymbol{\beta}_j + \varepsilon_{ij} \qquad i = 1,\dots, N;\ j = 1,\dots,J \tag{1}$$

where $J = 3$ is the number of possible alternatives, N is the number of farmers, $\mathbf{x}'_i$ is a row vector of case-specific variables that are supposed to influence this utility, $\boldsymbol{\beta}_j$ is a vector of coefficients to be estimated, ε_{ij} are random errors which are assumed to be independent and identically distributed across alternatives. This assumption is plausible since the alternatives analysed are not close substitutes and can therefore be assumed to be distinct (McFadden, 1974). Let Y_{ij} be the dependent variable with J outcomes numbered from 1 to J. After imposing the restriction $\boldsymbol{\beta}_1 = \mathbf{0}$, which allows the model to be identified, the choice probability is defined by the following multinomial logit framework:

$$Pr(Y_i = 1|\mathbf{x}'_i) = \frac{1}{1 + \sum_{k=2}^{J} \exp(\mathbf{x}'_i\boldsymbol{\beta}_k)} \tag{2}$$

$$Pr(Y_i = j|\mathbf{x}'_i) = \frac{\exp(\mathbf{x}'_i\boldsymbol{\beta}_j)}{1 + \sum_{k=2}^{J} \exp(\mathbf{x}'_i\boldsymbol{\beta}_k)} \qquad j = 2, \dots, J \tag{3}$$

Estimation of the model is obtained by maximising the following log-likelihood function:

$$\ln L = \prod_{i}^{N}\prod_{j}^{J} I(Y_i = j) \ln[Pr(Y_i = j|\mathbf{x}'_i)] \tag{4}$$

where $I(Y_i = j)$ is the indicator function of the farmer's choice, which takes 1 if $Y_i = j$ and 0 otherwise. Choice (1) is used as a base outcome. Therefore, the probability that either an organic or a conventional farmer diversifies is calculated relatively to that of a farmer who does not diversify. In this way, the effects of determinants on the choice of diversification are assessed by keeping organic farmers and conventional farmers separate. In addition, to analyse the different influence of specific characteristics of farmers who diversify (specifically, policy in favour of diversification, which does not concern farmers with no diversification strategies), a logistic model is also applied to a subset composed of farmers with diversification strategies where the binary response is the probability that organic farmers diversify. This allows us to further investigate the differences between the two different types of farmers by assessing the effects of specific factors on organic farmers relative to that produced on conventional farmers.

While in binary models coefficients $\boldsymbol{\beta}_j$ are easily interpretable, in multinomial logit models these coefficients show how predictors relate to the probability of observing a specific category relative to a base category and, therefore, indicate neither the direction nor the size of effects of predictors on the probability that an alternative is chosen (Wulff, 2015). To provide this information, average marginal effects are thus calculated. Marginal effects are the slope of the prediction function at a given value of the explanatory variable and inform about the change in predicted probabilities due to a change in a given predictor. For a continuous independent variable, the marginal effect related to coefficient *k*, farmer *i* and choice *j* is derived as follows:

$$ME_{kij} = \frac{\partial Pr(Y_i = j|\mathbf{x}_i')}{\partial x_{ik}} = Pr(Y_i = j|\mathbf{x}_i')(\beta_{kj} - \overline{\beta}_i) \quad (5)$$

where $\overline{\beta}_i = \sum_{j=1}^{J} \beta_{kj} Pr(Y_i = j|\mathbf{x}_i')$ is a probability weighted average of the coefficients for different choice combinations, β_{kj}. The average marginal effect is calculated over all the observations. For dummy variables, the marginal effect is defined by the discrete change in individual probabilities evaluated at the alternative values of the dummy (1 and 0).

3.2 The variables and the dataset used

As already specified, in the multinomial logit model the dependent variable is represented by the following categories: farms with no diversification strategies, which are used a base outcome, and two other options represented by farms that diversify and produce conventionally and farms that diversify and cultivate organically. The latter are used as a dependent variable in the logit model, which implies that organic farmers are compared with conventional farmers, both with diversification strategies. As independent variables, a set of socio-economic and political factors that are supposed to affect the probability of diversification are analysed. The selection of these variables depends on the main determinants of diversification that have been analysed in literature (see section 2) and on data availability. The variables taken into consideration refer to both farmer and farm characteristics as well as policy support. As regards farmer characteristics, education and age are analysed while, with reference to farm features, altitude, geographical localization, economic size and productive specialization are investigated. The level of education is represented by two binary variables. They are one if the farmer has a high level and a medium level of education, respectively. They are zero when the level of education is low. Age is modelled by a dummy indicating if farmers are young according to the threshold set by the CAP for accessing specific measures in favour of farmers with no more than 40 years of age.

Altitude is represented by two binary variables that take unitary value if farms are localized in flat areas and in hills, respectively, while they are zero if farms are located in the mountains. Geographical localization is described by a dummy that takes one if the farm is localized in Central-Northern Italy and zero if it is in Southern Italy. Economic size is represented by a dummy that takes value of one if the farm is large. It is zero in the case of small and medium-sized farms. Following a Eurostat (2016) classification, farms are identified as large if output is equal or higher than €25 thousand. As a measure of output, an average of gross marketable production (GMP) related to crops and livestock is calculated. Productive specialization is measured by four dummies related to arable crops, horticulture, livestock and permanent crops, respectively. Zero values indicate mixed specialization. Finally, policy is analysed by including CAP support per hectare related to the First Pillar and the RDP support in favour of diversification, expressed as a binary variable, which takes one if a farm received support.

The data used come from the Italian FADN. The sample analysed is composed of 51450 observations in the period 2014-2018. In this way, the effects of 2014-2020 CAP policy on the choice of diversification are analysed. 2018 corresponds with the latest year available. Observations are represented by different farms observed in one or more years. Since the farms that are present within FADN are subject to be changed over years, the analysis is conducted on pooled data. To take account of unobserved effects in different periods, dummies for the years 2015 to 2018 are added. If they are all zero, they indicate the year 2014.

The Italian FADN offers several data that can be used to identify farm diversification strategies (Table 1). These data refer to processing, direct farm sales, quality certification, agritourism, supply of mechanical, environmental, recreational and educational services, and other services such as rental of non-agricultural equipment and rooms for courses and seminars, craft and educational activities. Recalling the well-known and commonly used classification described in van der Ploeg and Roep (2003), processing, direct farm sales and quality certification can be included within the multifunctional direction of deepening, while the others are the result of broadening.[1] The presence of at least one

[1] van der Ploeg and Roep (2003) describe three types of multifunctional directions for farms: deepening, broadening and re-grounding. Deepening refers to all agricultural activities that are transformed, expand-

of the possible diversification activities can be inferred from economic information, data on policy support, list of certified products and processes and list of non-agricultural activities. The Italian FADN also allows the distinction between organic and conventional farms, indicating farms that are classified as organic.[2] By combining information on the presence of diversification with that relating to organic certification, it is possible to distinguish farms among organic farms that diversify, conventional farms that diversify and farms of any type without diversification strategies.

Table 2 shows the distribution of organic, conventional and all farms by kind of multifunctional direction. As can be noted, most farms undertake the direction of deepening, specifically processing. A small percentage of farms is oriented to broadening and an even smaller share combines both strategies. The differences between organic and conventional farms are not marked. However, organic farms are more oriented to deepening than broadening. Moreover, among organic farms with deepening, a higher share of farms process and sell products directly in comparison with conventional farms.

Table 3 shows some descriptive statistics of the sample used by logit models. The observations related to organic farms that diversify represent 12% of the entire sample and 74% of those related to all organic farms. Most are in Southern Italy (60%), operate in hills (60%) and have a medium-high level of education (about 70%). Moreover, they are prevalently specialized in permanent crops (54%) and received on average about 470 €/ha from the First Pillar of the CAP. Only 14% of the observations applied for RDP measures in favour of diversification. Compared to organic farms, conventional farms that diversify are relatively lower (58% of observations related to all conventional farms), are mainly localized in Central-Northern Italy (over 60% of observations), do not show a prevalently higher level of education and are less specialized in permanent crops (40%). They received on average 325 €/ha from the First Pillar of the CAP and nearly 30% of observations were supported by the Second Pillar.

4. RESULTS

Table 4 shows the results related to the multinomial logit model which assesses the effects of a selection of explanatory variables on the probability of diversification in organic and conventional farmers compared with farms with no diversification strategies. The significance associated with the likelihood-ratio test indicates that the model can be reasonably used to explain the reasons that lead farmers to diversify. McFadden's pseudo-R^2 can also be considered as acceptable.[3]

The coefficients related to localization show that there is a negative and significant relationship between the localization of organic farmers in Central-Northern Italy and the relative probability of diversifying, On the contrary, this relationship is positive in the case of conventional farmers. This means that organic farmers who diversify are more likely to localise in Southern Italy while it is more probable to find conventional farmers who diversify in Central-Northern Italy than farmers who do not diversify.

In relation to altitude, for both organic and conventional farmers the relationship between localization in flat areas and relative probability is negative while the one related to localization in hills is positive. Therefore, in both cases there is a higher probability that these farms localize in hills and do not localize in flat areas in comparison with farms that do not diversify. However, this probability appears to be slightly higher in organic farms.

As regards age, the coefficient associated with organic farms is positive and significant. This implies that organic farms that diversify are more likely to be younger compared to farms that do not diversify. On the contrary, the coefficient related to conventional farms is non-significant and no conclusion can thus be drawn.

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ed and/or relinked to other players and agencies in order to deliver products that entail more value added per unit precisely because they fit better with the demands in society at large. Broadening refers to the development of non-agricultural activities that enlarge the income flows of the farm enterprise, while they simultaneously imply the delivery of goods and services society is willing to pay for. Re-grounding occurs when the farm enterprise is grounded in a new or different set of resources and/or involved in new patterns of resource use. It refers to two specific fields of activity: pluri-activity and farming economically. Through pluri-activity the farm enterprise is partly built on off-farm income while farming economically is a strategy that raises income at farm enterprise level by reducing the use of external inputs and increasing the efficiency in the use of available internal inputs.

[2] In the Italian FADN, a farm is classified as organic if it is certified organic as a whole, there is at least one organic product or there is one process that is carried out with organic methods. This means that there could be mixed farms that combine organic and conventional farming. In this study, these farms are treated as organic.

[3] McFadden's pseudo-R^2 tends to be considerably lower than the R^2 index and should not be judged by the standards for a "good fit" in ordinary regression analysis. In fact, values of 0.2 to 0.4 represent an excellent fit (McFadden, 1978). Therefore, a value of 0.11 can be considered as acceptable. In any case, it should be stressed that the objective of the paper is to assess the influence of a battery of variables on the decision to diversify, focusing on those which are most analysed in literature and are of particular interest for this study. The search for further variables that can help to increase the goodness-of-fit of the model can be a future research direction.

Table 1. FADN variables used to identify on-farm diversification.

FADN Table	Variable	Direction
Economic accounts	Gross marketable production – Processing	Deepening
Economic accounts	Gross marketable production – Direct sales	Deepening
Policy	Measure 3.1 – New participation in quality schemes	Deepening
Policy	Measure 4.2 – Investments for processing/marketing and development	Deepening
Policy	Measure 4.4 – Non-productive investments	Broadening
Policy	Measure 8.1 – Afforestation/creation of woodland	Broadening
Policy	Measure 8.2 – Establishment and maintenance of agro-forestry systems	Broadening
Policy	Measure 8.6 – Investments in processing and marketing of forest products	Deepening
Policy	Measure 10.1 – Agri-environment-climate commitments	Broadening
Policy	Measure 10.2 – Genetic resources in agriculture	Broadening
Policy	Measure 15.1 – Forest-environmental and climate commitments	Broadening
Policy	Measure 132 – Participation of farmers in food quality schemes	Deepening
Policy	Measure 214 – Agri-environment payments	Broadening
Policy	Measure 221 – First afforestation of agricultural land	Broadening
Policy	Measure 222 – First establishment of agroforestry systems	Broadening
Policy	Measure 223 – First afforestation of non-agricultural land	Broadening
Policy	Measure 225 – Forest-environment payments	Broadening
Related activities	Agritourism	Broadening
Related activities	Craft activities	Broadening
Related activities	Educational activities	Broadening
Related activities	Mechanical services	Broadening
Related activities	Production of renewable energy	Broadening
Related activities	Recreational services	Broadening
Related activities	Rental of non-agricultural equipment	Broadening
Related activities	Rental of rooms for courses and seminars	Broadening
Related activities	Other services	Broadening
Certifications	Community eco-management and audit scheme (EMAS)	Broadening
Certifications	Environmental management system	Broadening
Certifications	Food safety management system	Deepening
Certifications	Integrated certified production	Broadening
Certifications	Intercompany traceability	Deepening
Certifications	Management system for hygienic self-control of products and processes	Deepening
Certifications	National zootechnical quality system	Deepening
Certifications	Protected designations of origin	Deepening
Certifications	Protected geographical Indication	Deepening
Certifications	Quality management system	Deepening
Certifications	Reduced environmental impact	Broadening
Certifications	Superior quality label (i.e. GMO free)	Deepening
Certifications	Traceability of the agri-food chain	Deepening
Certifications	Traditional agri-food product registered	Deepening
Certifications	Traditional specialities guaranteed	Deepening

Note: during the period 2014-2018, there are also payments related to the previous programming period (Measures 132, 214, 221, 222, 223, 225). To avoid the exclusion of farms that diversify and are supported by the past policy, these payments are also used for identifying diversification strategies. Measure 214 also includes payments in favour of organic farming. Since the focus is on policy in favour of diversification and organic farming is not here considered as a result of diversification, this measure was not considered in all cases where farms receiving support were organic farms or farms in conversion.

Table 2. Distribution of farms with diversification strategies by multifunctional direction, Italy, 2014-2018 (in %).

Direction	Organic Farms	Conventional Farms	All farms
Deepening	88.6	87.3	87.6
Processing	*98.2*	*97.0*	*97.2*
Quality certification	*64.5*	*70.8*	*69.4*
Direct sales	*52.0*	*46.7*	*47.9*
Broadening	6.5	8.4	8.0
Deepening & Broadening	4.9	4.3	4.4
Total	100.0	100.0	100.0

Note: the sum of processing, quality and direct sales is not 100 since the same farm can undertake one or more directions.

With reference to the education level, the relevant coefficients are positive and statistically significant indicating that it is more probable to find farmers with high and medium levels of education among farms that diversify in comparison with those with no diversification strategies. The coefficients associated with organic farms are largely higher and this shows the probability that organic farmers who diversify are more educated is higher than the one related to conventional farmers relatively to farms that do not diversify.

As far as economic aspects are concerned, the significant and positive coefficients associated with size demonstrate that there is a higher probability of diversifying in larger farms, and this is more evident for organic farmers.

About specialization, there is a positive and significant relationship between diversification and permanent crops in both types of farms, meaning that farmers who diversify are more likely to be specialised in permanent crops. This relationship is negative in other cases indicating that it is less probable that farms specialized in arable crops, horticulture and livestock diversify. The size of coefficients is larger in the case of organic farmers, therefore showing stronger relationships.

Concerning policy support from the First Pillar of the CAP, coefficients are significant, but the signs are opposed. As for organic farms, the positive coefficient shows that, as policy support increases, the likelihood that farms diversify increases in comparison with farms that do not diversify. Conversely, the negative coefficient associated with conventional farms indicates that farmers with higher support have a lower probability of diversifying.

Finally, dummies related to time show that the probability that farms diversify increased over time reaching the highest value in 2017.

Table 5 presents the marginal effects of explanatory variables calculated at the sample means. As mentioned in section 3.2, in contrast with coefficients, average marginal effects provide information about the relationship between alternatives and predictors independent of the base outcome. They measure the difference in probability of each of the outcome level associated with a change in each predictor variable. Consequently, coefficients and marginal effects have different interpretation and can provide different results. As regards organic farmers, the signs of the coefficients estimated by the multinomial logit model are confirmed, and all average marginal effects are significant. Results indicate that organic farmers localized in Central-Northern Italy and in flat areas have a probability of diversifying that is 7% and 6% lower than those localized in Southern Italy and in the mountains, respectively, as negative average marginal effects demonstrate. On the contrary, farmers operating in hills have a probability of diversifying that is 1% higher. Moreover, the likelihood that organic farms diversify is 3% higher in younger farmers and 6% and 12% higher in farmers with medium and high levels of education, respectively. From an economic point of view, larger farms are those where there is a higher probability of diversifying (+2%). With reference to specialization, the possibility of finding organic farmers who diversify is 3% higher in farms oriented to permanent crops than in mixed farms and is lower in other typologies of farms, especially among farms specialized in horticulture (-12%). The marginal effects associated with policy indicate that if policy support per hectare increases by one thousand units, the probability that an organic farm diversifies increases by 1%.

With regard to conventional farmers, not all marginal effects are consistent with coefficients in terms of direction and significance. Specifically, results show that conventional farmers operating in Central-Northern Italy and in hills have a probability of diversifying that is 7% and 4% higher than those localized in Southern Italy and in the mountains, respectively. Conversely, farmers operating in flat areas have a probability of diversifying that is 12% lower. Moreover, the likelihood that conventional farms diversify is 3% lower in younger farmers. It is also 2% lower in farmers with higher levels of education. These negative and significant relationships concerning age and education contrast with the results related to coefficients.

From an economic standpoint, the average marginal effect associated with size is positive but non-significant. Therefore, no conclusion can be drawn. With reference to specialization, conventional farms oriented to permanent crops have a probability of diversifying that is 6%

Table 3. Descriptive statistics about the sample used, Italy, 2014-2018.

	Mean	Standard deviation	Maximum*
Organic farms with diversification strategies (no. of obs. 6053)			
Located in Central-Northern Italy (dummy)	0.41	0.49	1
Located in flat land (dummy)	0.17	0.38	1
Located in hills (dummy)	0.60	0.49	1
Young farmers (≤ 40 years) (dummy)	0.21	0.41	1
Farmers with high-level education (dummy)	0.15	0.36	1
Farmers with medium-level education (dummy)	0.53	0.50	1
Large (≥ 25 € thousand of avg. GMP) (dummy)	0.70	0.46	1
Specialized in arable (dummy)	0.11	0.31	1
Specialized in horticulture (dummy)	0.03	0.17	1
Specialized in permanent crops (dummy)	0.54	0.50	1
Specialized in livestock (dummy)	0.20	0.40	1
First Pillar CAP payments per hectare (€)	466.56	604.00	10061.95
Supported by the second Pillar CAP for diversification (dummy)	0.14	0.35	1
Conventional farms with diversification strategies (no. of obs. 25088)			
Located in Central-Northern Italy (dummy)	0.63	0.48	1
Located in flat land (dummy)	0.24	0.43	1
Located in hills (dummy)	0.52	0.50	1
Young farmers (≤ 40 years) (dummy)	0.13	0.33	1
Farmers with high-level education (dummy)	0.06	0.23	1
Farmers with medium-level education (dummy)	0.43	0.50	1
Large (≥ 25 € thousand of avg. GMP) (dummy)	0.68	0.47	1
Specialized in arable (dummy)	0.19	0.39	1
Specialized in horticulture (dummy)	0.07	0.25	1
Specialized in permanent crops (dummy)	0.37	0.48	1
Specialized in livestock (dummy)	0.27	0.44	1
First Pillar CAP payments per hectare (€)	325.25	571.11	40618.18
Supported by the second Pillar CAP for diversification (dummy)	0.27	0.44	1
Farms with no diversification strategies (no. of obs. 20309)			
Located in Central-Northern Italy (dummy)	0.65	0.48	1
Located in flat land (dummy)	0.46	0.50	1
Located in hills (dummy)	0.34	0.47	1
Young farmers (≤ 40 years) (dummy)	0.12	0.32	1
Farmers with high-level education (dummy)	0.04	0.20	1
Farmers with medium-level education (dummy)	0.39	0.49	1
Large (≥ 25 € thousand of avg. GMP) (dummy)	0.70	0.46	1
Specialized in arable (dummy)	0.31	0.46	1
Specialized in horticulture (dummy)	0.16	0.37	1
Specialized in permanent crops (dummy)	0.16	0.36	1
Specialized in livestock (dummy)	0.31	0.46	1
First Pillar CAP payments per hectare (€)	395.34	1759.88	121033.9
Supported by the second Pillar CAP for diversification (dummy)	0.00	0.00	0

* Minimum values are always zero.

Table 4. Estimation of the multinomial logit model for organic and conventional farmers with diversification strategies compared with farmers with no diversification strategies.

	Organic farmers		Conventional farmers	
	Coefficients	Standard Deviation	Coefficients	Standard Deviation
Intercept	-1.250*	0.075	0.572*	0.048
Localization				
Central-Northern Italy (dummy)	-0.614*	0.033	0.144*	0.021
Altitude				
Flat land (dummy)	-1.246*	0.049	-0.849*	0.029
Hills (dummy)	0.282*	0.041	0.224*	0.027
Mountains (baseline)				
Age				
Young farmers (≤ 40 years) (dummy)	0.316*	0.044	-0.025	0.032
Education level				
High-level education (dummy)	1.436*	0.060	0.281*	0.049
Medium-level education (dummy)	0.712*	0.036	0.151*	0.022
Low-level education (baseline)				
Economic size				
Large (≥ 25 € thousand) (dummy)	0.275*	0.036	0.096*	0.023
Specialization				
Arable (dummy)	-1.499*	0.064	-0.908*	0.040
Horticulture (dummy)	-2.149*	0.090	-1.340*	0.046
Permanent crops (dummy)	0.610*	0.055	0.421*	0.040
Livestock (dummy)	-1.002*	0.059	-0.648*	0.039
Mixed (baseline)				
Policy				
First Pillar CAP payments per hectare**	0.045*	0.009	-0.127*	0.020
Time				
2014 (baseline)				
2015 (dummy)	0.314*	0.055	0.107*	0.032
2016 (dummy)	0.486*	0.053	0.101*	0.031
2017 (dummy)	0.692*	0.052	0.178*	0.031
2018 (dummy)	0.651*	0.052	0.168*	0.032

Number of observations = 51450

Likelihood-ratio test $\chi^2(32)$ =11045.95

Prob>χ^2=0

McFadden's pseudo R^2=0.111

* Statistically significant at 1%; ** coefficients and standard deviations are multiplied by 1000 for improving reading.

higher than the one of mixed farms. The other types of farms have lower probabilities, which reach the lowest value in farms specialized in horticulture (-18%). The marginal effect related to policy indicates that an increase of one thousand units in policy support per hectare decreases the probability of diversifying in conventional farms by 3%.

Table 6 shows the results related to the logit model, where the explanatory variables are regressed against the binary response probability of diversification in organic

Table 5. Marginal effects of explanatory variables related to the multinomial logit model.

	Organic farmers		Conventional farmers	
	Coefficients	Standard Deviation	Coefficients	Standard Deviation
Localization				
Central-Northern Italy (dummy)	-0.066**	0.003	0.072**	0.004
Altitude				
Flat land (dummy)	-0.063**	0.004	-0.121**	0.006
Hills (dummy)	0.012**	0.003	0.035**	0.006
Mountains (baseline)				
Age				
Young farmers (≤ 40 years) (dummy)	0.031**	0.004	-0.025**	0.007
Education level				
High-level education (dummy)	0.116**	0.005	-0.023*	0.010
Medium-level education (dummy)	0.057**	0.003	-0.009	0.005
Low-level education (baseline)				
Economic size				
Large (≥ 25 € thousand) (dummy)	0.020**	0.003	0.005	0.005
Specialization				
Arable (dummy)	-0.083**	0.005	-0.119**	0.008
Horticulture (dummy)	-0.117**	0.008	-0.179**	0.010
Permanent crops (dummy)	0.031**	0.004	0.060**	0.008
Livestock (dummy)	-0.053**	0.005	-0.089**	0.008
Mixed (baseline)				
Policy				
First Pillar CAP payments per hectare***	0.012**	0.001	-0.032**	0.005

* Statistically significant at 5%; ** Statistically significant at 1%; *** coefficients and standard deviations are multiplied by 1000 for improving reading.

farmers only compared with conventional farms that diversify. The likelihood-ratio test shows that the model as a whole fits significantly better than a model with no predictors. The negative and significant coefficients associated with Central-Northern Italy and flat land indicate that, in comparison with conventional farmers with diversification strategies, organic farmers who diversify have a lower probability to be localized in Central-Northern Italy and in flat areas. The coefficient related to hills is positive but non-significant, meaning that both types of farmers have the same probability of being localized in hills. As regards socio-demographic aspects, the positive and significant coefficients indicate that it is more likely that organic farmers who diversify are younger and have higher levels of education compared to conventional farmers. Organic farms that diversify are also larger than the conventional ones as the coefficient relevant to economic size demonstrates. Regarding specialization, the signs of coefficients, which are all significant, show that there is a higher likelihood that diversification is present in organic farmers specialized in permanent crops as well as a lower probability that organic farmers who diversify are specialized in arable crops, horticulture and livestock.

The positive and significant coefficient related to policy support from the First Pillar of the CAP confirms that organic farmers with higher support have a higher probability of diversifying than diversified conventional farms. On the contrary, the coefficient associated with policy support from RDP in favour of diversification is significant but negative. This means that there is lower probability of diversifying in organic farmers who receive support from the RDP.

Table 6 also provides information about average marginal effects. The effects estimated are consistent in terms of direction with those shown in Table 5 and can

Table 6. Estimation of the logit model for organic farmers compared with conventional farmers with diversification strategies and average marginal effects.

	Organic farmers		Average marginal effects	
	Coefficients	Standard Deviation	Effects	Standard Deviation
Intercept	-1.858*	0.072	-	-
Localization				
Central-Northern Italy (dummy)	-0.676*	0.032	-0.094*	0.004
Altitude				
Flat land (dummy)	-0.506*	0.049	-0.071*	0.007
Hills (dummy)	0.021	0.038	0.003	0.005
Mountains (baseline)				
Age				
Young farmers (≤ 40 years) (dummy)	0.388*	0.040	0.054*	0.006
Education level				
High-level education (dummy)	1.265*	0.053	0.176*	0.007
Medium-level education (dummy)	0.589*	0.034	0.082*	0.005
Low-level education (baseline)				
Economic size				
Large (≥ 25 € thousand) (dummy)	0.206*	0.034	0.029*	0.005
Specialization				
Arable (dummy)	-0.583*	0.061	-0.081*	0.009
Horticulture (dummy)	-0.862*	0.090	-0.120*	0.013
Permanent crops (dummy)	0.186*	0.049	0.026*	0.007
Livestock (dummy)	-0.272*	0.055	-0.038*	0.008
Mixed (baseline)				
Policy				
First Pillar CAP payments per hectare**	0.409*	0.030	0.057*	0.004
Second Pillar CAP support for diversification (dummy)	-0.665*	0.043	-0.093*	0.006
Time				
2014 (baseline)				
2015 (dummy)	0.162*	0.053		
2016 (dummy)	0.385*	0.051		
2017 (dummy)	0.531*	0.050		
2018 (dummy)	0.543*	0.050		

Number of observations = 31141

Likelihood-ratio test $\chi^2(17)$ =3220.12

Prob>χ^2=0

McFadden's pseudo R^2=0.105

* Statistically significant at 1%; ** coefficients and standard deviations are multiplied by 1000 for improving reading.

be interpreted analogously. An additional result is related to the positive and significant effect concerning the Second Pillar of the CAP, which shows that the organic farmers not receiving support from the RDP have a probability of diversifying that is 9% higher than that of farmers who are supported. This implies that among conventional farmers who do not receive support this probability is 9% lower.

5 DISCUSSION

Results indicate that farmers who diversify have different geographical localization. Organic farmers are mainly localized in Southern Italy while conventional farmers can be prevalently found in Central-Northern Italy. This partly contrasts with Dries *et al.* (2012) who find that the likelihood to observe diversification is higher in Southern Italy due to more difficult socio-economic conditions that favour the development of non-traditional activities to complement agricultural income. In our study, a higher probability of diversifying also involves conventional farms located in Central-Northern Italy and is a consequence of the territorial distribution of farmers. In fact, about 60% of organic farmers who diversify are in Southern Italy, against 35% of conventional farmers. A common finding is that that diversification is less widespread among farms operating in flat areas. This is likely due to the fact that the more competitive farms that are localized in flat areas have a lower need to expand their activity and increase their income than farms located in less favoured areas (Dries *et al.*, 2012).

As far as the characteristics of farmers are concerned, results show that education level contributes to explaining diversification strategies. Specifically, farmers with higher levels of education diversify more frequently in accordance with other studies (McElwee and Bosworth, 2010; Boncinelli *et al.*, 2017, 2018). This confirms that the lack of education and skilled labour may represent major barriers to finding opportunities within the new challenges of agricultural business (Khanal, 2020). However, among conventional farmers, those who are most likely to diversify are not farmers with the highest levels of education, although they are more educated than those who do not diversify.

Farmer's age also influences the probability of engaging in diversification activities but with contrasting effects. This might explain why controversial results can be found in literature. In the case of conventional farms, farmers do not exhibit clear differences compared to farmers with no diversification strategies. However, within the group of conventional farms, older farmers seem to be more oriented to diversification as others studies have shown (Joo *et al.*, 2013). Conversely, in organic farms, there is higher propensity of younger farmers to diversify, which is consistent with the findings of Barbieri and Mahoney (2009), who have stressed that longer-term ties would lead younger farmers to strengthen the existing farm business through diversification for future generations.

Looking at economic and structural aspects, it turns out that the economically largest farmers are those who diversify the most, independently of their model of production. The reason could be that the reduction of marginal returns determines that farms' resource allocation is addressed towards more profitable activities (McNamara and Weiss, 2005; Ilbery, 1991; McNally, 2001) or more simply that larger farmers have more resources to bound to other activities than agriculture (García-Arias *et al.*, 2015). Specialization is another factor explaining the choice of diversifying in both organic and conventional farmers. Farmers specialized in permanent crops are found to diversify to a larger extent in line with findings by Dries *et al.* (2012). This higher tendency to diversification may be due different reasons (Salvioni *et al.*, 2020). Firstly, farms that allocate most of the agricultural area to permanent crops may have limitations in managing risks through crop diversification. For this, they may be characterized by lower and more concentrated seasonal harvests than farms specialized in herbaceous crops, which raise a problem of underuse of labour force during the rest of the year. Additionally, products from permanent cropping systems (i.e., olive oil and wine) are better suited to differentiation-based marketing strategies. These factors increase the likelihood for farms to diversify, in particular towards processing and direct sale, which represent widespread diversification strategies in farmers specialized in permanent crops.

As regards policies, both Pillar 1 and 2 payments affect the propensity to diversify production consistently with previous studies (Bartolini *et al.*, 2014). However, the effects on organic and conventional farmers are opposed. In the case of conventional farmers, results indicate that Pillar 1 payments negatively affect the choice of diversifying. The explanation could be that these payments, by producing a wealth effect, reduce the need to increase income by diversification. Conversely, in organic farmers, the effects are positive. Farmers who receive a higher support tend to diversify to a larger extent than the average. In this case, the higher financial resources made available by the CAP are likely to be used to finance diversification. Therefore, for organic farmers, the motivation pushing to diversification does not seem to integrate income but to expand activity by taking advantage of benefits from both organic production in terms of consumers' willingness to purchase at higher prices and diversification in relation to the possibility of obtaining an even higher value added (Zander, 2008; Sidali *et al.*, 2019). With reference to the Second Pillar of the CAP, payments affect positively diversification adoption but only in conventional farmers. Conversely, these payments do not exert any influence on organic farmers. Results even show that organic farmers that diversify apply for policy measures supporting diversification to a lesser extent. This is a further confirmation of different motivations leading conventional and organic farmers to diversify.

In interpreting the results, some possible drawbacks deriving from the approach used here should be taken into consideration.

A first potential drawback comes from the fact that the sampled farms that do not diversify include both organic and conventional farms and that the latter represent the majority (around 90%). Therefore, one of two comparisons is substantially between organic farms that diversify and those conventional which do not diversify. In addition, the fact that organic farms that diversify represent most organic farms (about 70%) implies that this comparison is basically between organic farms and conventional farms, and that the results are therefore affected by the main characteristics and differences of organic farms in comparison with the conventional ones. However, this does not compromise the main findings of this study but, on the contrary, strengthens the conclusion that organic farming and on-farm diversification are strongly connected with each other.

A further and possible drawback deriving from mixing organic and conventional farms that do not diversify is that these two types of farms can exhibit marked differences which can explain why a conventional farm decides to convert to organic farming and would suggest that farms that do not diversify should also be kept separate. For example, marginality conditions and difficulties in reaching the same profitability as that of more competitive conventional farms due to agricultural constraints can be some of these reasons. However, this may be valid for a part of farms, especially for those which decide to convert. In fact, it has been shown that organic farms are mostly present in areas with favourable socioeconomic and climatic conditions, both globally but also within countries, and that, within developed countries, the locations of organic crop farmers often do not differ significantly from the locations of conventional crop farmers (Malek *et al.*, 2019). Moreover, for a share of farms, particularly for new entrants, organic farming may represent an effective strategy to capture the economic opportunities provided by the current changes in the market and consumers' preferences regardless of the presence of agricultural constraints. This allows conventional and organic farming to be viewed in the same way as business strategies and is consistent with the main objective of the paper of understanding the reasons why a farm decides to diversify rather than converting to organic farming. From a methodologic point of view, keeping organic and conventional farms that do not diversify also separate means that two distinct logit models should be performed in the place of a single multinomial model. Although this can be a useful exercise for future research, which can provide further information, in this way, the coefficients of the models estimated separately for organic and conventional farms as well as the relevant marginal effects could not be compared directly.

6. CONCLUSIONS AND POLICY IMPLICATIONS

This paper aimed to analyse the possible differences between organic and conventional farms in relation to the reasons that lead farmers to diversify. The focus is on the Italian FADN sample of farms observed in the period 2014-2018. From a methodological standpoint, multinomial and binary logit models, linking the probability that several alternatives are chosen to a few territorial, socioeconomic, and political factors, are adopted. The approach used is based on the consideration that organic farming should not be considered as one of the possible options of diversification available to conventional farms but a model of production that may respond to different logics.

Results suggest that, in both organic and conventional farms, diversification might not be necessarily an obliged passage for marginal farms which desire to survive. On the contrary, it can be more assimilated to an entrepreneurial strategy that requires specific competences and adequate organization. However, the reasons for diversifying differ according to the kind of production model. In the case of conventional farming, farmers might decide to diversify because they are not able to reach income levels comparable with those of a more competitive and highly mechanized agriculture due to factors related to localization, specialization, and lower support from the First Pillar of the CAP. Therefore, they diversify to increase their income using policy support from the RDP in favour of diversification. Conversely, in the case of organic farming, diversification seems to be an integrated part of the production model. Organic farmers are likely to implement new activities, particularly processing and direct sales, to take advantage of benefits from both organic production and diversification, regardless of the policy support for diversification. For these farms, localization in less competitive areas and specialization in permanent crops might not be necessarily weakness factors, but rather distinctive characteristics that can be further enhanced by the diversification pattern.

These results highlight some possible policy implications. A first consideration is that the incentives to implement diversification strategies appear to be ineffective in organic farms. A reason can be related to profitability reasons and the existence of synergies between different activities. The benefits, net of costs and administrative burdens, which can be obtained by requesting public support for diversification, may be lower than the benefits deriving from combining organic farming with diversification without asking for support. Therefore, organic farmers can afford not to request support, or they do not express the need to request it at all. This can be positive as it can mean that organic farming, combined with diversification, allows farmers to reach levels of competitiveness that make the request for public support for diversification unnecessary. However, it must be considered that organic farmers, compared to conventional ones, also benefit from specific support for the conversion and maintenance of organic farming and this raises the question of how to better distribute the funds in favour of diversification between different types of farming in order to make policy more targeted and effective. A further consideration is more general and concerns both organic and conventional farms. Results show that diversification strategies are undertaken prevalently by larger farms with higher levels of education. This means that smaller and family farms, which would benefit from on-farm diversification, do not diversify and this might depend on the lack of resources as well as on low skills and entrepreneurial capabilities, which prevent them from accessing policy support. Therefore, administrative simplification as well as training and consultancy services specifically designed for this category of farms should be strengthened to avoid abandonment of agriculture, particularly in marginal areas. In the context of organic farming, this strategy could leverage the greater presence and propensity of young farmers to diversify and would be in line with recent European policy indications aimed at giving a significant acceleration in the growth of the organic sector.

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